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OF THE

MASSACHUSETTS MEDICAL SOCIETY.

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APPENDIX TO CATALOGUE OF 1896.

Admissions reported since January 1, 1896.

1896	Averill, George Goodwin	Boston.
1896	Ayer, Thomas Herbert	Worcester.
1896	Barney, Charles Norton	Boston.
1896	Bean, Charles Pierce	Boston.
1896	Bernauer, Emil Constantine	Dorchester.
1896	Blossom, Anne Mooers	North Adams.
1896	Boyd, James Van Wagner	Springfield.
1896	Branch, Charles Franklin	Amherst.
1896	Brousseau, William Gilbert	Boston.
1896	Bruce, John Angus	Everett.
1896	Brunelle, Pierre	Lowell.
1896	Bullock, George Dexter	Weymouth.
1895	Byrne, Charles Armstrong	Hatfield.
1896	Carleton, Dudley	Springfield.
1895	Child, Edward Moses	Florence.
1896	Church, Mary Violet	Roxbury.
1896	Coggswell, William	Boston.
1896	Cronin, Henry William	Millbury.
1896	Daly, William Joseph	Boston.
1896	Dewey, David Robert	North Adams.
1896	Dodd, Isaac Spencer Fanning	Pittsfield.
1896	Dolliver, George Carroll	Boston.
1896	Farrell, George Louis	Malden.
1896	French, John Innis	Boston.
1896	Frissell, Edward Merle	Webster.
1896	Gray, Elizabeth Taylor	Roxbury.
1896	Guild, Thomas Ezra	Mattapan.
1895	Hanley, Francis Joseph	Whitman.
1896	Hart, George Fred	Webster.
1896	Hill, George Hillard	Worcester.
1896	Holland, James William	Westfield.
1896	Holmes, Harry Clinton	Cambridge.
1896	Hughes, Laura Ann Clesphos	Boston.
1896	Kelleher, Patrick Francis	Boston.
1896	Lyons, Joseph Benedict	Charlestown.
1896	McAdams, James Philip	Lowell.
1896	Macdonald, Alexander Ambrose	Roxbury.
1896	McIntosh, Herbert	Boston.
1896	McNamara, Eugene Thomas	Boston.
1896	Mahoney, George Clifton	Somerville.
1896	Merrill, Arthur Ellsworth	Somerville.
1896	Metcalf, Ben Hicks	Boston.

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1896	Minsall, Arthur Gladstone	Northampton.
1896	Morse, Frank Leander	Boston.
1896	Mosher, Frank Orson	Boston.
1896	Muttart, George Morley	East Boston.
1896	Painter, Charles Fairbank	Boston.
1896	Patch, Annie Sophia Kenney	Boston.
1896	Pearl, Frederick Warren	Boston.
1896	Potter, Francis Mason	Boston.
1896	Rand, Richard Baxter	North Abington.
1896	Rawson, George Wallace	Amherst.
1896	Rice, Walter Henry	Brookline.
1896	Sanderson, Mary	Worcester.
1896	Savage, John James	Lowell.
1896	Sawyer, Frank Wade	Everett.
1896	Scales, Robert Bass	Dorchester.
1896	Silva, Francis Pierce	Charlestown.
1896	Sosnoski, Philip	Roxbury.
1896	Steele, John McClary	Worcester.
1896	Stiles, Herbert Kendall	Roslindale.
1896	Stone, Moses Cornelius	Dorchester.
1895	Stowell, Joab, Jr.,	North Amherst.
1896	Sturgis, Walter Horatio Wakeman	Hull.
1896	Thompson, John Joseph	Webster.
1896	Watson, Walter Linwood	Weston.
1896	White, Franklin Warren	Boston.
1896	White, Leonard Darling	Uxbridge.

List of Deceased Fellows.

Admitted.	Name.	Residence.	Date of Death.	Age.
1858	Cogswell, George Badger	North Easton	March 6, 1896	61
1872	Copeland, George Walter	Middleborough	April 30, 1896	50
1874	Cushman, Thaddeus Thompson	Randolph	Feb. 6, 1896	76
1848	Dickerman, Lemuel	Foxborough	Aug. 14, 1895	69
1879	Dunbar, Eugene Fillmore	Roxbury	Feb. 20, 1896	44
1868	Forster, Edward Jacob	Boston	May 15, 1896	49
1895	Harriman, Frank Whitman	Boston	Jan. 7, 1896	21
1880	Harmon, Samuel Tappan	Boston	Feb. 7, 1896	37
1853	Hodges, Richard Manning	Boston	Feb. 9, 1896	68
1865	Johnson, Amos Howe	Salem	May 12, 1896	64
1884	Kelley, George Wallace	Passadena, Cal.	May 20, 1896	39
1845	Newell, Robert Wingate	Boston	April 9, 1896	81
1853	Randall, George Henry	No. Rehoboth	Jan. 18, 1896	70
1878	Rich, Joshua Bartlett	Worcester	Feb. 25, 1896	51
1876	Robinson, Walter Scott	Taunton	June 4, 1896	57
1848	Slade, Daniel Denison	Chestnut Hill	Feb. 11, 1896	72
1853	Stetson, John	West Harwich	Feb. 19, 1896	81
1883	Stevens, Frank Dana Switzer	Lynn	Feb. 13, 1896	35
1843	Thomson, George Newton	Boston	July 13, 1895	82
1846	Warren, Royal Sibley	Col. Sp'gs, Col.	Feb. 13, 1896	73
1884	Weil, Frank Edward	No. Andover	Jan. 6, 1896	35
1869	Whitney, James Orne	Pawtucket, R.I.	Jan. 24, 1895	71
1865	Wigglesworth, Edward	Boston	Jan. 23, 1896	55
1878	Wyman, Samuel Edwin	Cambridge	May 7, 1896	43

The following have been allowed to retire:

Charles Blodgett, of Holyoke.
George D. Colony, of Fitchburg.
Horace M. Holmes, of Adams.
Charles Jordan, of Wakefield.
John A. Lamson, of Boston.
Alonzo C. Webber, of Cambridge.

The following have been allowed to resign:

Gardner Cox, of Holyoke.
Horace Fox, of Philadelphia, Pa.
Richard P. Francis, of Montclair, N. J.
Albert R. Moulton, of Philadelphia, Pa.
Joseph W. Warren, of Bryn Mawr, Pa.

ARTICLE I.

THE ANNUAL DISCOURSE.

THE ADVANCEMENT OF MEDICINE BY RESEARCH.

By HENRY P. BOWDITCH, M.D.
OF BOSTON.

DELIVERED JUNE 10, 1896.

NOTE.—At an Adjourned Meeting of the Massachusetts Medical Society, held Oct. 3, 1860, it was

Resolved, "That the Massachusetts Medical Society hereby declares that it does not consider itself as having endorsed or censured the opinions in former published Annual Discourses, nor will it hold itself responsible for any opinions or sentiments advanced in any future similar discourses."

Resolved, "That the Committee on Publications be directed to print a statement to that effect at the commencement of each Annual Discourse which may hereafter be published."

THE ADVANCEMENT OF MEDICINE BY RESEARCH.

Mr. President and Fellows
of the Massachusetts Medical Society:

The recent attempt by the Society for the Prevention of Cruelty to Animals to secure legislation for the restriction of biological research in Massachusetts and the probability[1] that the attempt will be repeated during the next session of the legislature, may serve as my excuse for asking you to consider the history and significance of the movement, the inevitable result of its success, as well as the moral principles which here find their application.

That the Legislature of Massachusetts should be requested to restrict the right of physicians to study their profession, and of the higher educational institutions of the state to teach the sciences on which the practice of medicine rests, is a phenomenon which surprises no one who has watched the progress of the so-called "antivivisection" agitation during the last quarter of a century. At various times within this period have the efforts of misguided benevolence been directed to checking the progress of medical science by interfering with one of the most important methods by which advances can be made. Fortunately for humanity these efforts have, in nearly all cases,

been rendered futile by the sound common sense of the community. In England alone, of all civilized countries, has a certain amount of success crowned the efforts of fanatical agitators and, by the enactment of a restrictive law, a serious blow has been inflicted upon English physiology.

In the presence of such an agitation it is of course to the members of the medical profession that the community, distressed by the constant repetition of tales of imaginary atrocities, will naturally turn for the assurance that teachers of the medical sciences are not brutes and criminals, and that medical students are not young ruffians who delight in blood and suffering. It is, therefore, important that physicians should be at all times ready to explain to the laity how, as Dr. J. G. Curtis has happily expressed it, "in the slowly woven fabric of achievement pure science and applied science, biology and medicine, have always been warp and woof."

It requires no professional training to comprehend that a knowledge of the bodily functions in their normal state is essential for the understanding and treatment of those derangements of function which constitute disease, and that physiology, which deals with these normal functions, must, therefore, form the basis upon which medical science and medical practice alike must rest. Now nearly all the phenomena of life which form the subject matter of physiology are either physical or chemical in their character. In fact physiology must be regarded as the physics and chemist-

ry of living bodies. Therefore, just as the physicist and the chemist build upon the basis of experiment the solid superstructure of their sciences, so the physiologist can hope to advance firmly and successfully to the discovery of the laws of life only on the condition that the same experimental method supplies the stepping stones for his progress.

Self-evident as this proposition seems to the student of nature's laws, certain persons are ready to deny the legitimacy of the experimental method of research when applied to living bodies, while they admit it to be absolutely indispensable in the case of non-living matter. The cause of this attitude of mind is not difficult to discover. In fact it has its origin in the noblest feelings of human nature, in the sentiment that bids us be merciful as we would obtain mercy. Those who hold these views, profoundly impressed by what they conceive to be the painful nature of experiments performed on living animals and by the alleged indifference to animal suffering shown by the experimenters, have not hesitated to bring charges of cruelty against those who are engaged in seeking to penetrate the mystery which still surrounds the actions and reactions of living organisms and thus to lay, broad and deep, the foundations on which the medical science of the future is to be built up.[2]

I have used the words "misguided benevolence" in speaking of this agitation, and there is no doubt that many, though unfortunately not all, of the persons engaged in this crusade are benevolent in

their disposition and conscientious in their attitude, but it it should be remembered that, as Mr. Roosevelt recently remarked: "Conscience without common sense may lead to folly which is but the handmaiden of crime."

In judging of the moral and mental attitude of those who are engaged in this mischievous agitation, it is important to distinguish carefully between the leaders and the followers. The former are fortunately very few in number, but by their activity and apparent ubiquity they easily create an impression of being in much larger force. Dominated by the single idea that vivisection is an "abominable thing and hateful in the sight of God," they presume to teach lessons of humanity to the members of a profession which exists for the relief of suffering. Unable to comprehend the reports of biological investigations published for professional readers, they recklessly denounce perfectly painless experiments as cases of fiendish torture.[3] Deliberate and authoritative statements setting forth the necessity of animal experimentation for the advancement of medical science, the vast amount of good already accomplished and the comparatively trifling amount of the suffering involved, are treated simply as falsehoods such as might naturally be expected from the "cowardly criminals" who practice vivisection.[4]

This movement is, therefore, by no means to be regarded as a simple humanitarian effort to reduce to a minimum the amount of animal suffering connected with vivisection. Restrictive laws like that

of England are denounced as useless, and the total abolition of the practice is imperatively demanded.[5] That this will have the effect of seriously checking the advance of medical science some of the leaders ignorantly deny, while others contemplate this result with satisfaction, for they deny the right of the human race to profit by animal suffering, and condemn the saving of a human life by the sacrifice of that of a dog. That this is not an exaggerated statement of the position assumed by antivivisectionists, a single quotation from the writings of Henry Bergh will suffice to show. Mr. Bergh was for many years president of the New York Society for the Prevention of Cruelty to Animals, and was throughout his life the acknowledged leader of the antivivisectionists in America. In a lecture[6] on this subject delivered in 1880 occurs the following passage: "As another proof of the profane extremes to which these dissectors of living animals will go, Robert McDonald, M.D., on being questioned, declared that he had opened the veins of a *dying person*, remember, and had injected the blood of an animal into them, many times, and had met with brilliant success. In other words this potentate has discovered the means of thwarting the decrees of Providence, where a person was dying, and snatching away from its Maker a soul which He had called away from earth!" It seems to me that this blasphemous denunciation of a physician for saving a human life needs absolutely no comment.

It might naturally be supposed that such extravagances of statement would carry their own refutation, and would demand no more attention from serious people than the utterances of those medical philosophers who deny the utility of vaccination. Acting upon this supposition, and unmindful of the fact that lies travel faster than truth, biological investigators have, as a rule, not thought it necessary to contradict specifically the various misstatements which have been published with regard to their work. The result has been that certain excellent people, of emotional dispositions and without the special training which would enable them to judge correctly of such a question, have been led to believe that so much smoke must indicate some fire. They have, therefore, by joining antivivisection societies, lent the weight of their names and their purses to a movement fraught with danger to the welfare of the State. That members of our own profession have occasionally expressed themselves in such a way as to encourage this agitation is to be deplored, but not wondered at, for no one listens more sympathetically to a tale of suffering than a true tender-hearted physician; and if he does not happen to be in a position to contradict from his own knowledge the heart-rending stories which are poured into his ears, he may be readily convinced of the existence of abuses requiring legislative interference.

Recognizing the true nature of the antivivisection agitation, it is evident that educated phy-

sicians would be false to their high calling did they not resist with all their energy the attacks of an enemy whose success would destroy all hope of establishing medicine in the position to which it is rightfully entitled, that of the most important branch of biological science.

In thus maintaining their right to study and teach their profession, physicians are not called upon to maintain that unnecessary pain has never in the history of the world been inflicted in connection with vivisection. Their true contention should be:—

(1) That the men in charge of the institutions where vivisections are practised in this State are no less humane than those who desire to supervise their actions, while they are, at the same time, vastly better informed with regard to the importance of animal experimentation and the amount of suffering which it involves.

(2) That no abuse of the right to vivisect has been shown to exist in these institutions.

(3) That the governing bodies of these institutions possess both the will and the power to put a stop to such abuses should they arise.

(4) That the existing statutes furnish sufficient protection against cruelty in vivisection as well as against cruelty in general.

(5) That for the reasons above given legislation on this subject is wholly uncalled for.

These propositions define substantially the position assumed by this Society in the resolution adopted four years ago in response to a communication

from the Massachusetts Society for the Prevention of Cruelty to Animals,[7] and, with the medical profession united in their defence, no fear need be felt that our legislature will ever yield to the pressure of fanatical agitation to the detriment of the best interests of the community.

A full account of the origin and progress of the antivivisection agitation would, of course, be impossible within the limits of this discourse, but it will be well to refer briefly to the history of the movement in other communities, calling attention to certain points which are full of instruction and warning for ourselves.

The first serious attack upon biological research in England seems to have been made in an essay entitled "Vivisection, is it Necessary or Justifiable?" published in London in 1864 by George Fleming, a British army veterinary surgeon. This essay is an important one, for though characterized at the time by a reviewer in the London Atheneum as "ignorant, fallacious, and altogether unworthy of acceptance,"[8] its blood-curdling stories, applied to all sorts of institutions, have formed a large part of the stock in trade of subsequent antivivisection writers.

A fresh stimulus to the agitation was given by the publication in 1871 of a work edited by Prof. J. Burdon Sanderson, entitled "Handbook for the Physiological Laboratory." This book was intended to be used by students of physiology under the guidance of their instructors, and contained a description of the experimental basis on which

modern physiology rests. Unfortunately, however, it fell into the hands of excitable men and women, who were ignorant of many things which had properly been taken for granted in writing for members of the medical profession. That anæsthetics, for instance, would be used in all cases to which they are applicable, was tacitly assumed just as it would be in a work on operative surgery. In consequence of this failure to comprehend the object for which the book was written, many well meaning but too impulsive people jumped "to the conclusion that raw medical students were being encouraged to repeat for their pleasure, every experiment that had ever yielded results, careless whether the subjects were conscious or unconscious of pain." This misconception tended to produce an excited state of popular feeling which was intensified by the performance at the meeting of the British Medical Society in 1874 of some experiments on dogs, showing the difference between alcohol and absinthe in their physiological action. The excitement culminated in the appointment of a Royal Commission to enquire into the subject. The result of the investigation was a report which cannot be better described than in the language of Lord Sherbrooke (better known as the Right Honorable Robert Lowe).[9] "The commission entirely acquitted English physiologists of the charge of cruelty. They pronounced a well-merited eulogium on the humanity of the medical profession in England. They pointed out that medical stu-

dents were extremely sensitive to the infliction of pain upon animals, and that the feeling of the public at large was penetrated by the same sentiment. * * * * They then proceeded to consider to what restrictions they should subject the humane and excellent persons in whose favor they had so decidedly reported. Their proceeding was very singular. They acquitted the accused, and sentenced them to be under the surveillance of the police for life." Remarkable as was this conclusion of the commission, the action of Parliament based upon it was still more extraordinary, for a law was enacted which, taken in connection with the previous legislation, has brought about a state of things in England which has been well described as one "in which it is penal to use domestic animals in any way cruelly, but in which any one may torture wild creatures in whatever fashion he likes *provided it is not for scientific purposes.*"

The amount of mischief which may be produced by this English law depends very much upon the good judgment of the Home Secretary, to whom its enforcement is entrusted. The most eminent members of the medical profession in England have at times been refused a license to perform experiments which they declared to be of the greatest importance for medical science,[10] and, in general, it may be said that the system of licensing and government inspection under which biological research work must be conducted is, under the most favorable conditions, a source of serious annoyance to investigators, while it does not secure

any better guarantee for the humane treatment of animals than is afforded by the character of the men engaged in the work.

The system, moreover, fails entirely to satisfy the antivivisectionists who, in support of their demand for a prohibitory law, continually circulate the most exaggerated and perverted accounts of experiments performed in licensed and inspected laboratories.[11]

The first outbreak of the antivivisection agitation in this country occurred in New York some fifteen or sixteen years ago,[12] when the State Society for the Prevention of Cruelty to Animals, under the leadership of Henry Bergh, attempted to secure the passage of a law prohibiting the practice of vivisection. The agitation was conducted with so much fanaticism, and the method of garbled quotation employed by Mr. Bergh was exposed so effectively by the late Dr. J. C. Dalton,[13] that the legislature not only declined to enact any restrictive laws, but maintained in full force an amendment to the general law against cruelty to animals adopted in 1867, providing that "nothing in this act contained shall be construed to prohibit or interfere with any properly conducted scientific experiments or investigations, which experiments shall be performed only under the authority of the faculty of some regularly incorporated medical college or university of the State of New York."

New York has thus set an excellent example to her sister States in protecting her men of science, in their attempts to enlarge the bounds of human

knowledge, from the vexatious interference of persons who can know nothing of the importance of the work or of the amount of suffering which it involves.

In Pennsylvania also, attempts to secure restrictive legislation have been made by the American Antivivisection Society, which has its headquarters in Philadelphia, but the energetic protests of the medical profession have sufficed to render these attempts abortive.

In Washington, during the present session of Congress, the efforts of the local humane societies have been so far successful that the Committee on the District of Columbia has brought before the Senate a bill providing for the licensing and restricting of vivisection,[14] but there seems to be little reason to fear that such a bill will become a law.

In Massachusetts, the State Society for the Prevention of Cruelty to animals has, until quite recently, treated this question with moderation and good sense. While regretting the necessity for sacrificing animal life for the advancement of science, and anxious, like all right minded people, to reduce the sufferings of such animals to a minimum, it has not seen in the existing state of things any reason for demanding additional legislation or for taking any action under laws already in force. A few years ago the president of the Society publicly called attention[15] to the failure of the antivivisection agitation, both in this country and in Europe, to effect any reduction in the num-

ber of animals subjected to experiment, and maintained that the proper attitude of the Society should be one of coöperation with the best men of the medical profession in seeking to prevent any abuses from arising in connection with the practice of vivisection. To the friends of the Society who rejoice in the good work it has been able to accomplish in the community, it must be a matter for sincere regret that this wise policy has been abandoned, and that the Society now finds itself arrayed in opposition not only to the medical profession, but also to the higher educational institutions of the Commonwealth.[16] It is, however, but just to state that this position seems to have been assumed without any formal action by the governing body of the Society.[17]

The bill first presented by the Society to the legislature of 1896 provided that no painful experiments upon living animals should be performed in any educational institution of the State, except under the authority of the State Board of Health, and that the Massachusetts Society for the Prevention of Cruelty to Animals might supervise all such experiments. Violations of the law were to be punished by fines which, when collected, were to be turned over to the Society.

During the hearings before the Judiciary Committee of the House this bill was twice modified, first by the omission of the section relating to the State Board of Health, and of the clause requiring the fines to be paid into the treasury of the Society, and subsequently by providing that the agents of

the Society employed to supervise vivisections should be doctors of medicine.[18] The petitioners for this legislation were, one after another, compelled to acknowledge under cross-examination, that they were unable to present any evidence of cruelty practised in the educational institutions of Massachusetts in connection with vivisection, while the remonstrants, by a straightforward account of what actually occurs in physiological laboratories and by an exposure of exaggerations and misstatements with which antivivisectionist literature abounds, sought to convince the committee of the mischievous character of the agitation and of the unfortunate results which would necessarily follow the proposed legislation. Shortly after the close of the hearings the committee presented a unanimous report recommending "that the petitioners have leave to withdraw."

Having thus called your attention to a few salient points in the history of the antivivisection movement and indicated the methods employed by the leaders of this crusade against the work of a profession whose glory is to save, let me next ask you to consider the reasons which not only justify students of medical science in resorting to experiments upon living animals, but require them to do so as a necessary condition of any important advance.

In dealing with this question I shall make free use of a work entitled "Physiological Cruelty, or Fact *v.* Fancy, by Philanthropos." This book, which appeared in 1883, contains by far the most com-

prehensive, logical and dispassionate discussion of the subject with which I am acquainted.

The vivisection question reduced to its simplest expression may be stated as follows: "Have we a right to give pain to animals in order to study the phenomena of life?" In answering this question we perceive at once the necessity of a clear conception of what pain really is, and in striving to obtain this conception we are struck by the fact that pain is a purely subjective phenomenon. We *know* absolutely nothing about pain, except that which we have ourselves suffered. We infer, of course, when we hear another person describe a painful sensation, that his feelings are similar in a general way to those which we imagine we ourselves should experience under like circumstances. This assumption of similarity of sensation is justified by the facts of our common human nature; but we are often struck, when listening to such descriptions, by the apparent difference between the impressions produced upon different individuals by the same external cause. A trifling surgical operation, which will not be considered worth mentioning by one individual, will, to another, be apparently the source of most acute suffering. We are thus led to suspect that, even in the circle of our own acquaintances, there must be quite a wide range of sensibility to pain. If we extend our observation over a wider field, we find reason to believe that in the human race there is a certain rough proportionality between sensibility to pain and intellectual development. A

case is recorded, for instance, of a Russian serf who, while splitting logs in a forest, was caught by the thumb in the crack of a large log from which the wedge had unexpectedly flown out. He tore himself free from his painful imprisonment, as a wild animal might have done, leaving the thumb in the log, with the long tendons of the forearm still attached to it. It is doubtful if a more civilized man could have subjected himself to this operation even with the alternative before him of an indefinite imprisonment in the forest. The cruel tortures which savages inflict upon their friends and themselves, as in the initiation rites of the Mandan warriors,[19] seem to be best explained on the supposition that their sensibility to pain is less acute than that of civilized races.

In the case of the lower animals the evidence of a low sensibility to pain is much more conclusive. Among our domestic animals the horse and dog are commonly regarded as standing nearest to man in intelligence and sensibility, and yet nearly everyone who has had much to do with these animals will recall instances of great indifference shown by them to what would be to us severe pain. A single illustration of this insensibility may suffice. A horse whose leg was badly broken was sentenced to be shot, but during the two hours which intervened between the sentence and the execution the animal limped about to graze, dragging the fractured limb dangling behind it in a way which would have caused a human being exquisite agony. It is evident, therefore, that it is

entirely impossible to draw conclusions with regard to the sensations of animals by an effort to imagine what our own would be under similar circumstances. Our common human nature, which serves as a guide, though an imperfect one, in estimating the sufferings of other human beings, fails us entirely when we have to do with animals, and we are left to draw conclusions from cries, motions and other external signs of suffering. Now these external signs are apt to be misleading, for they only prove "that something is going on which the organism repels," but do not prove that the animal is conscious of what is going on. In other words, the cries and struggles of an animal whose skin is cut or burnt belong to that class of phenomena known as "reflex actions"; *i.e.* they are movements having their origin in impressions made on the terminations of the nerves, and not in impulses coming from the nerve centres in the brain. They may be accompanied by consciousness, but consciousness, so far from being necessary for their production, acts rather to check and interfere with their manifestation.

We are all perfectly well aware that when the spinal cord of an animal has been divided in the cervical region, an impression made upon the nerves of the skin, either by a sharp instrument or a chemical irritant, will cause the animal to execute violent movements of very definite character, adapted to remove the source of irritation and differing in no respect, except perhaps in increased energy, from the movements of a perfectly unin-

jured animal. But in this case we know that the movements are not attended by consciousness, for by division of the spinal cord the channel by which impressions are conveyed to the nerve centres, whose activity is a necessary condition of consciousness, is entirely obliterated. The movements are, in fact, no more indicative of suffering than are the convulsive flutterings of a decapitated chicken. We can speak with great positiveness upon this point, for the testimony of hospital patients suffering from injuries to the spinal cord shows clearly that violent reflex movements of the lower limbs may occur absolutely unattended by consciousness. It is, moreover, a matter of common experience that in certain stages of anæsthesia consciousness may be entirely abolished, while the activity of the lower reflex centres remains unaffected. In such cases patients may struggle and scream during an operation, but subsequently declare they have suffered no pain.

It is evident, therefore, that great caution must be exercised in drawing conclusions with regard to the sensations of animals from the external signs of suffering which they manifest when undergoing operations, and that the "spasm of agony" of sensational writers is in most cases much better described as a nerve-muscle reaction.

We have thus seen that for the production of a painful sensation three things are necessary:

First, the stimulation of a sensory nerve or its terminations.

Second, the transmission of the stimulus to the

nerve centres whose activity is associated with consciousness.

Third, the response of these nerve centres to the stimulus thus received.

Pain may then be defined as the *consciousness of the excessive stimulation of a sensory nerve.* This definition excludes those cases in which the brain is narcotized or separated from the rest of the nervous system so that there can be no consciousness of the stimulation of the nerve, however severe it may be, and also those cases where the stimulation of the nerve is moderate in amount and therefore gives rise to agreeable sensations. The precise point where the stimulus of a nerve ceases to be moderate and agreeable and becomes excessive and painful cannot be determined with precision, for a stimulation which is moderate for one individual will be excessive for another, or for the same individual at a different time. The strong alcoholic liquor, for instance, which pleasantly titillates the throat of the drunkard, will sear the delicate mucous membrane of the child unaccustomed to its use.

Having thus arrived at a definition of pain and noted that the phenomenon in man and the lower animals is similar in kind though vastly different in degree, we recur to the original question: Have we a right, in studying the phenomena of life, to inflict upon animals whatever pain may be necessary for the attainment of our object? This leads us to consider the broader question, how far it is right that one individual should suffer for the

good of another, and this again involves the still broader problem, how far the prospect of future good may compensate for present evil. A full discussion of these questions would carry us far beyond the limits of this discourse. For our present purpose it will be sufficient to note the fact that we unhesitatingly submit ourselves and subject those we love to physical suffering for the sake of future benefit which we think will outweigh the present pain. Nor is this deliberate choice of present evil for the sake of future good limited to those cases in which the evil and the good are both experienced by the same individual. The law of vicarious suffering, by which pain to one individual secures pleasure to another, is a law from whose operation we cannot escape if we would, and, however much we may at times rebel against it, a calm consideration forces us to recognize its stern beneficence. The law which bids us bear one another's burdens, and that which declares that the sins of the fathers shall be visited upon the children, tend powerfully to bind the human race together and contribute perhaps more than any other causes to the development of the moral sense. We see then that there is nothing repugnant to our moral feelings in the abstract idea that one individual should suffer for the benefit of another, and if we accept this principle, as indeed we *must*, when applied to two individuals belonging to the highest grade of sentient creatures, there is still less reason for rejecting it when the suffering individual belongs to a lower grade than

the individual who is benefited, since, for the reasons already given, the suffering, in this case, bears a smaller proportion to the benefits obtained than when both individuals are equally highly organized. Moreover, when the sufferings of the lower animals have as a result not a benefit to a single individual but an increase of human knowledge, the disproportion between the suffering and the benefit becomes practically infinite, for the suffering remains a constant quantity while the benefit, since it accrues to the whole human race and through all time, is multiplied by an infinite factor.

Admitting, then, that there is no abstract reason why animals should not suffer for the benefit of man, it remains to be considered whether we have a "right to constitute ourselves adminstrators of this law of vicarious suffering and to apply it to animals for our own interest." The right of man to inflict pain upon the lower animals for his own benefit has never been very distinctly formulated. Our relations to the wild denizens of the forest, field and stream are very largely an inheritance from those times when our savage ancestors disputed with the lower animals for the right to exist on the face of the earth. In fact they do not differ materially, except in degree of complication, from the relation of the lion to the lamb or the hawk to the dove.

In the words of the author of the above mentioned work on "Physiological Cruelty," "It is generally admitted that we may chase and kill an animal, often necessarily with much pain, not be-

cause its life and liberty interfere with ours, but because its death will render our life more complete, perhaps in the most trivial detail. We kill them (without anæsthetics) not only that we may have food and clothing, but that the food may be varied and attractive and the clothing rich and beautiful. We subject them to painful mutilations in order to make them more manageable for service, to improve the flavor of their flesh, and even to please our whimsical fancies. We imprison them in cages and zoölogical gardens, to improve our knowledge of natural history, or merely to amuse ourselves by looking at them. It is abundantly clear that in all our customary dealings with animals we apply to them without scruple the law of sacrifice, and interpret it with a wide latitude in our own favor. * * * * * * So far, the general principle of dealing with animals which is in a vague way accepted by most humane persons * * * * * * * seems to be that we may kill, inconvenience, or pain them, for any benefit, convenience, or pleasure to ourselves, but that the pain must be within moderate limits (of course undefined), and that it must form no element in our pleasure." Now the point to be specially emphasized in this connection is that physiologists, in experimenting with living organisms, cause an amount of suffering utterly insignificant compared with that which animals are called upon to endure in other ways, and that the suffering thus caused is inflicted with a motive and with an expectation of benefit quite adequate to justify the infliction of

a much greater amount of pain that even the most serious operations in the laboratory can be supposed to produce.

In this respect the physiologist stands, it seems to me, on higher moral ground than that occupied by most persons whose occupation leads them to sacrifice animal life. Compare, for instance, the occupation of a sportsman with that of a physiologist. It is difficult to imagine how an animal such as a deer or a rabbit can be made to endure greater physical agony than in being hunted to death by hounds. It is hard to conceive of animal suffering more entirely out of proportion to the object sought and gained by it than that produced by the average sportsman whenever he fires a charge of shot into a flock of birds, since, for every bird actually killed, several more will probably be wounded, and, escaping with broken wings, fall an easy prey to their enemies or perish from starvation. Yet we inflict this suffering, not because we need the animal for food, not because its existence interferes in any way with our own, not because we expect to derive any permanent benefit from its destruction, but simply, as the word "sport" implies, because we are in search of amusement and the sufferings of the animal are incidentally associated with our enjoyment of the moment. It must not be supposed that I desire to bring the charge of cruelty against sportsmen, for, of course, the fact that the animal suffers pain forms no part of the pleasure of the hunter; nor do I overlook the great benefit which the sportsman derives in-

cidentally from his pursuit in the acquirement of health, strength and skill. I merely wish to point out, first, that, as far as the charge of cruelty is concerned, the physiologist may claim the same exemption which is accorded to the sportsman, for, so far from enjoying the sufferings of the animals on which he experiments, it is his constant object to reduce those sufferings to a minimum; and secondly, that, with regard to a justification for the infliction of pain, the advantage is on the side of the physiologist, for the desire to enlarge the bounds of human knowledge and to fix firmly the foundations of the healing art must be regarded as a higher motive than the wish to secure one's own temporary amusement, and moreover the proportion between the benefit obtained and the pain inflicted is much larger in physiological experimentation than in the vocation of the sportsman.

In this connection it is interesting to contrast the fate of the victims of science with that of similar animals living in a state of nature. In doing this we are struck by the vast amount of animal suffering which the laws of nature necessitate. The weak are inevitably the victims of the strong. The chain of destruction extends throughout the animal creation, and every link involves the death of victims under circumstances which, from a human point of view, seem those of revolting cruelty. The cat plays with the mouse, apparently enjoying its terror and distress. The butcher-bird impales its living victims on the

thorns of the locust tree, thus laying up in its hideous larder a store of food often far beyond its needs. The larger carnivora tear their living prey limb from limb. In fact the relations of animals to each other are such as to fully justify, from a moral standpoint, an indictment for cruelty against nature herself. With regard to domestic animals the case is often not much better. The vagrant cur and the prowling cat lead a life of constant terror, eking out a miserable existence amongst piles of garbage, and dying finally, when physical strength fails, from sheer starvation. Compared with misery like this the fate of the chosen victim of science may well be regarded as enviable, for once within the laboratory precincts warmth and abundant food are assured, and, though the term of life is shortened, its closing scene is often absolutely painless, and is, in any case, likely to be attended with less suffering than a so-called natural death.

With regard to physiological experiments which involve operations of a painful nature upon living animals, it is desirable for us to ascertain as accurately as possible the amount of suffering thus caused. The first important fact to be here noted is that the great boon conferred upon mankind in the discovery of anæsthetics extends its beneficent influence over the animal world as well. Just as no modern surgeon ever thinks of performing a severe surgical operation without placing the patient under the influence of ether or chloroform, so no physiologist neglects to use an anæsthetic

when performing a prolonged or painful experiment except in those rare cases in which its administration would interfere with the result of the experiment. Even on the supposition, which too many sensational writers are prone to make, that a physiologist is absolutely regardless of the amount of suffering which he causes, he will still be compelled to use an anæsthetic for his own convenience in order to suppress the cries and struggles of the animal, which would otherwise disturb the adjustment of his delicate instruments and interfere with the mental concentration essential for the proper performance of his work. This very concentration of the mind upon the work in hand prevents, of course, any active feeling of sympathy with the animal experimented upon, but the same may be said of the surgeon who, however tender-hearted he may be, never in operating allows his mind to wander from the work in which his hands are engaged. Neither the one nor the other can be charged with cruelty or inhumanity.

In this connection it may be well to allude to the question whether curare, a drug much used by physiologists, is or is not an anæsthetic. This substance is the arrow poison of certain tribes of South American Indians, and has the property of paralyzing the voluntary muscles. The earlier experiments of Claude Bernard on frogs, showing that sensory nerves are not affected by the poison, led him to the conclusion that an animal poisoned by curare preserves his sensibility to pain, but has lost the power of giving any sign of suffering.

Strictly speaking, Bernard's experiments only show that the drug affects the sensory nerves and the spinal cord less readily than the motor nerves, while they throw no light on the question of the persistence of consciousness, but the fact that they succeed equally well after the removal of the cerebral lobes seems to exclude consciousness from any important participation in the phenomena. The arguments which have sometimes been used to sustain the proposition that curare increases the sensibility to pain would prove also that small doses of morphia have the same effect, whereas we know that morphia in small doses diminishes and in larger doses annihilates the sensibility to pain. Thus the weight of physiological evidence seems to be in favor of the view that curare may be to some extent an anæsthetic, though it is not employed by physiologists for that purpose. Psychological evidence pointing in the same direction may also be urged, for, on the theory promulgated and ably defended by Prof. William James, that all emotions are but the conscious recognition of the reflex actions produced by the exciting cause of the emotions, it seems evident that so much of the substratum of the feeling of pain as is dependent upon the reflex contraction of voluntary muscles must, in cases of curare poisoning, be absolutely wanting.[20]

Of the possibly painful physiological experiments which we are now considering, it has been calculated by Professor Yeo that seventy-five per cent. are rendered absolutely painless by the use

of anæsthetics; but it must be admitted that the giving of an anæsthetic to an animal is not the same agreeable operation that it is to a human being. The animal does not understand the reason why it is compelled to breathe a vapor which is gradually depriving it of its consciousness, and usually struggles against the administration of it, thus rendering some sort of forcible confinement necessary. The inconvenience thus occasioned to the animal is, of course, overbalanced in the case of prolonged or serious operations by the exemption from subsequent suffering. When, however, the operation is of a trifling character it is doubtless more merciful to the animal to dispense with the use of anæsthetics. For the complete understanding of this portion of the subject it should be mentioned that a large portion of the animals thus rendered insensible for physiological purposes are killed after the experiment has been performed and before the effect of the anæsthetic has passed off. Where the object of the research is to observe the subsequent effect of the operation, it is, of course, necessary to allow the animal to recover from the anæsthetic and to endure whatever pain may be connected with the healing of its wounds. This has, however, been reduced to insignificance by the modern methods of antiseptic surgery, the discovery of which was led up to by physiological experiments, and the benefits of which are now experienced by the brute creation as well as by the human race.

Accepting Prof. Yeo's estimate that seventy-five

per cent. of the possibly painful physiological experiments are rendered absolutely painless by the use of anæsthetics, it remains to be considered how much suffering attends the remaining twenty-five per cent. of these experiments; and here it is important, in all discussions of this subject, to correct a rather prevalent popular notion that a wound is painful in proportion to its depth. The fact is, however, that sensibility to pain is, in a healthy body, confined almost wholly to the surface. A consideration of the function of the sensory nerves shows us why this should be the case, for these nerves are distributed only to points where under normal circumstances they can receive stimulation, and thus serve to bring the organism into relation with the outer world. Pain, caused by excessive stimulation of a sensory nerve, is the sign that the integrity of the body is threatened by some external agency, and at this signal the body reacts consciously or unconsciously to ward off the threatened danger. Now external agencies can act upon the body only at the surface. Hence sensory nerves distributed to internal organs would have no *raison d'être;* and, in the wise economy of nature, we find, accordingly, that they do not exist. The apparent contradiction to this statement furnished by the painful sensations, *e.g.* cramps and colics which we sometimes experience in our internal organs are really illustrations of the same general law, for the pain in this case is the indication of some *morbid* action of an organ, and is usually the sign that rest is necessary to enable the organ to re-

cover its normal condition. It is a matter of common experience, therefore, that the cutting of the skin is the only really painful part of even quite serious operations. As the knife divides the deeper organs no pain is felt, except indeed when a sensory nerve-trunk is divided, which operation is attended by a momentary flash of pain. Even the brain, the seat of consciousness itself, is no exception to this rule, for its substance may be cut and operated on in various ways without causing the slightest pain. It is evident, therefore, that in a large proportion of the actually painful experiments performed in physiological laboratories the pain must be of the briefest duration, since it is almost wholly confined to the preliminary incision. It must also be borne in mind that a large class of experiments consists in the introduction of drugs under the skin, an operation about as painful as vaccination or as a subcutaneous injection of morphia. Bearing these facts in mind we are well prepared to accept Prof. Yeo's estimate, and that of the twenty-five per cent. of actually painful experiments, twenty per cent. are about as painful as vaccination, four per cent. about as painful as the healing of a wound, and one per cent. as painful as an ordinary surgical operation performed without anæsthetics.[21]

I have thus sought to set before you the material for forming a judgment with regard to the amount of animal suffering which the practice of experimental physiology involves. It remains for me now to speak of the value of the discoveries thus

made or, in other words, to present to you briefly the evidence of the debt owed by the practising physician of the present day to the physiologists of the past. We shall then be in a position to answer the question whether on the whole "vivisection pays." To enumerate all the discoveries that have been made in physiology by means of experiments on animals would be utterly impossible within the limits of this discourse, for there is hardly a single organ of the human body whose functions have not been investigated and explained in this way. It will suffice at this time to call your attention to a few of the more important physiological discoveries which form the groundwork of our knowledge of the human body and to ask you to imagine, if you can, what would be the condition of the healing art if these discoveries had never been made.

To begin with, let us consider the circulation of the blood, the discovery of which bears somewhat the same relation to medicine that that of the law of gravitation bears to physics. It is well known that the ancients believed the arteries, as their name implies, to be tubes containing air. When Galen, in the second century of our era, studied the arteries on living animals, the fact that they carry blood was of course apparent. The circulation of the blood was, however, far from being made out. In fact it was not till the beginning of the seventeenth century that Harvey, gathering up the learning of the time, contributed by the great Italian teachers, Vesalius, Eustachius, Fallopius, Fabricius

of Aquapendente, and others, and making important additions of his own (as he himself says) "by frequently looking into many and various living animals,"[29] was finally able to promulgate the true theory of the circulation of the blood. Since the time of Harvey our knowledge of the conditions under which the blood circulates has been greatly extended, and always by means of experiments upon living animals. The pressure which the blood exerts upon the walls of the vessels in different parts of its course has been carefully measured. The fact that its white globules can pass through the vascular walls into the tissues outside has been clearly demonstrated, and forms, in fact, the basis of the modern theory of inflammation. The influence of the nervous system in controlling the size of the channels through which the blood circulates, thus regulating the nutrition of the tissues, the activity of the organs and the distribution of the heat, has been studied by a host of observers, and is, indeed, one of the most fruitful fields of modern physiological research. It is difficult to imagine what the practice of medicine would be without this knowledge which has been wholly obtained by experiments on living animals, and which is now the common property of educated physicians. It has indeed been very pertinently asked: "how will those earnest antivivisectionists, who like Miss Cobbe prefer to 'die sooner than profit by such foul rites,' provide themselves with a medical attendant warranted ignorant of the circulation of the blood?"

The direct benefits received from animal experimentation are perhaps more obvious in surgery than in the other departments of medicine. The proper mode of applying ligatures to arteries and the antiseptic treatment of wounds have reached their present stage of perfection largely through experiments on the lower animals. To give you a vivid idea of the privileges which we are now enjoying I will ask you to listen to Ambrose Paré's description of an amputation as performed in his time.[23] "I observed my masters whose method I intended to follow, who thought themselves singularly well appointed to stanch a flux of blood when they were furnished with various store of hot irons and caustic medicines, which they would use to the dismembered part, now one, then another, as they themselves thought meet, which thing cannot be spoken or but thought upon without great horror, much less acted. For this kind of remedy could not but bring great and tormenting pain to the patient, seeing such fresh wounds made in the quick and sound flesh are endured with exquisite sense. * * * * And verily of such as were burnt, the third part scarce ever recovered, and that with much ado, for that combust wounds with difficulty come to cicatrization; for by this burning are caused cruel pains, whence a fever, convulsion, and oft times other accidents worse than these. Add hereunto, that when the eschar fell away, oft-times a new hæmorrhage ensued for stanching whereof they were forced to use other caustic and burning instruments. * * * * Through which occasion

the bones were laid bare, whence many were forced, for the remainder of their wretched life, to carry about an ulcer on that part which was dismembered; which also took away the opportunity of fitting or putting to an artificial leg or arm, instead of that which was taken off."

Let us now contrast this ghastly picture with the methods of a modern amputation. The patient is first made unconscious by the use of ether or chloroform. The blood vessels of the limbs are then emptied by means of an elastic bandage. Hardly a drop of blood is shed in the amputation itself, the divided arteries are firmly tied and the wound, treated antiseptically, heals with little or no pain. At every step in the process which has led to this brilliant result experiment has been the guide. Various technical details of the method remain still to be worked out. It is this beneficent work which antivivisectionists seek to abolish.

I will allude to but one other benefit conferred upon suffering humanity by scientific experiments involving the sacrifice of animal life: The therapeutic use of antitoxine, though still in its infancy, shows by the unimpeachable records of hospital practice that the physician has now within his grasp the means of successfully treating one of our most dreaded diseases. The anxiety, almost amounting to despair, with which a physician formerly approached a serious case of diphtheria, has given place to a feeling of well grounded hope of a favorable result. Who can estimate the burden of terror and distress thus removed from the anxious

watchers by the bedside, and who will dare to say that the boon has been dearly purchased by the lives of some thousands of guinea pigs?[24]

Let us now briefly review the points over which we have already passed. We have seen, in the first place, that pain is a purely subjective phenomenon, the sensibility to which differs very much in different individuals and is in the lower animals reduced apparently much below that of the least sensitive human beings, and that, moreover, the external signs of suffering are apt to be misleading unless the conditions under which these signs are made are well understood, a knowledge which can be acquired only by careful physiological study. We have seen, in the second place, that pain is only relatively an evil, that we submit to it ourselves and subject others to it for the sake of subsequent advantages which we consider sufficiently important. Thirdly, we have seen that our relations to animals are such that there is no well recognized objection to our causing them very great suffering for the sake of very slight benefits to ourselves. In this matter there is, of course, great room for improvement. The practical question always is "how much suffering may we inflict on an animal for the sake of how little benefit to ourselves?". In the progress of civilization there is a constant tendency to draw the line more and more in favor of the animal, but when we remember how much opposition was, within a few years, arrayed in this State against the passage of a law to abolish pigeon shooting we cannot flatter ourselves that we have,

as yet, reached any very advanced humanitarian stand-point. It is certainly no very extravagant concession to the rights of animals to enact that they shall not be set up as living targets at a shooting match when glass balls thrown into the air will answer the same purpose. In forming and fostering a public opinion which demands a greater consideration for the brute creation the societies for the prevention of cruelty to animals have played an important part and their work would doubtless be still more effective were they in the habit of making more frequent applications of the results of physiological research to the problems of animal life. By the efforts of these societies and by the general growth of humane sentiments in the community, we may expect that a larger and larger prospective benefit will be demanded as a justification for the infliction of pain upon animals. To this raising of the requirements of humanity physiologists will be certain to offer no objection, provided the same rule is applied to all occupations involving pain to animals; for it is evident, I trust, from what has been said, that a standard, so high as to be practically inapplicable to the daily affairs of life, will still leave a wide margin for the carrying on of physiological research. A questionable practice cannot of course be justified by demonstrating that another still less justifiable practice exists, but it may be fairly urged that while practices are permitted which cause great suffering to animals with only incidental benefits to mankind, "it is irrational folly," to quote a writer in *Na-*

ture, "to waste the energy of humanitarian feeling in a warfare against the only kind of pain-giving practice which is directed toward the mitigation of pain, and which has already been successful in this its object to a degree out of all proportion to the pain inflicted."

Enough has been said, I trust, to demonstrate the expediency of permitting physiological research to go on unchecked, and even of encouraging it in every possible way, as the only legitimate basis of scientific medicine. Before leaving the subject, however, it is well to notice that whatever restrictions be imposed on the physiologist working in his laboratory, the advancement of medicine by experiment will be certain to go on. Agitation cannot check it. Legislation cannot prevent it. Once admit, what no one thinks of disputing, that physiological phenomena are chemical or physical in their character, and the position of physiology among the experimental sciences is a matter of necessity. All that legal enactments can do is to determine to some extent who shall be the experimenters and who the victims of the experiments. Shall practising physicians grope blindly in search of methods of treatment when chance brings disease under their observation, or shall men of science, systematically studying the nature and results of morbid processes in animals, point out to the practitioner the path to be followed to render innocuous the contagion of our most dreaded diseases? In illustration of this point permit me to quote a few lines from Dr. John Simon's address on State Medi-

cine.[25] "The experiments which give us our teaching with regard to the causes of disease are of two sorts; on the one hand we have the carefully prearranged and comparatively few experiments which are done by us in our pathological laboratories, and for the most part on other animals than man; on the other hand we have the experiments which accident does for us, and above all the incalculably large amount of crude experiment which is popularly done by man on man under our present ordinary conditions of social life, and which gives us its results for our interpretation. * * * Let me illustrate my argument by showing you the two processes at work in identical provinces of subject matter. What are the classical experiments to which we chiefly refer when we think of guarding against the dangers of Asiatic cholera? On the one side there are the well-known scientific infection experiments of Professor Thiersch, performed on a certain number of mice. On the other hand there are the equally well known popular experiments which during our two cholera epidemics of 1848–49 and 1853–54 were performed on half a million of human beings, dwelling in the southern districts of London, by certain commercial companies which supplied those districts with water. Both the professor and the water companies gave us valuable experimental teaching as to the manner in which cholera is spread. * * * * Now, assuming for the moment that man and brute are of exactly equal value, I would submit that, when the life of either man or brute is to be made merely instru-

mental to the establishment of a scientific truth, the use of the life should be economical. Let me, in that point of view, invite you to compare, or rather to contrast with one another, those two sorts of experiment from which we have to get our knowledge of the causes of disease. The commercial experiments which illustrated the dangerousness of sewage-polluted water supplies cost many thousands of human lives; the scientific experiments which, with infinitely more exactitude, justified a presumption of dangerousness cost the lives of fourteen mice."

We see then that in one way or another experiment must form the basis on which medical science is to be built up. The question for us to decide is, "Shall these experiments be few, carefully planned, conclusive, economical of animal life, or shall they be numerous, accidental, vague and wasteful of human life?". I think in settling this question we may safely take for our guide the words of Him who said, "Ye are of more value than many sparrows."

APPENDIX.

[1] [*From "Our Dumb Animals," May, 1896.*]

OUR BATTLE AT THE STATE HOUSE.—We have had *three* hearings before "*The House Judiciary Committee*," and large audiences, for a law intended to permit us to ascertain whether by cruel vivisection there is in any of our educational institutions any violation of the laws of Massachusetts enacted for the prevention of cruelty to animals.

* * * * *

After three hearings, and despite of all that we and our able attorney, *James H. Bailey Jr., Esq.*, have been able to do we have been defeated, and until another session of the legislature we can have no legal right to witness in any of these colleges or schools the experiments performed on living animals.

* * * * *

Possibly another year Harvard University may decide to throw open its own doors and cease to oppose a law which will give us power to obtain information in regard to *all the other educational institutions* of our State.

(Signed) GEO. T. ANGELL.

[2] My attention has kindly been called to the following passage in Bacon's writings, showing that this great philosopher fully appreciated the importance of experiments upon animals as a foundation for medical science.

"In the inquiry which is made by anatomy I find much deficience: for they inquire of the parts, and their substances, figures, and collocations; but they inquire not of the diversities of the parts, the secrecies of the passages and the seats or nestling of the humours, nor much of the footsteps and impressions of diseases. * * * And for the passages and pores, it is true, which was anciently

noted, that the more subtile of them appear not in anatomies, because they are shut and latent in dead bodies, though they be open and manifest in live: which being supposed, though the inhumanity of *anatomia vivorum* was by Celsus justly reproved; yet in regard of the great use of this observation, the inquiry needed not by him so slightly to have been relinquished altogether, or referred to the casual practices of surgery; but mought have been well diverted upon the dissection of beasts alive, which notwithstanding the dissimilitude of their parts may sufficiently satisfy this inquiry."—*Advancement of Learning, Book 2, x 5.*

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[3] In 1885 the writer reported the results of experiments on cats in which the sciatic nerve was divided under ether and the *peripheral* end subsequently subjected to prolonged stimulation. Although this stimulation could not by any possibility have been accompanied by any sensation the experiments are continually cited in antivivisectionist literature as cases of atrocious cruelty. Mr. Philip G. Peabody, for instance, comments as follows: "It will be readily seen, even by the casual reader, that it involves an amount of agony beyond which science is unable to go and to approximate to which is impossible except by a person who has devoted long years to the study of nerves."—*Leaflet published by the N. E. Antivivisection Society.*

These same experiments were classified by Miss F. P. Cobbe ("Nine Circles," 2d ed., p. 15) as operations on the *spine*, and to prove that they must have been painful a statement from Landois & Stirling's Physiology is quoted to the effect that hemisection of the spinal cord produces hyperæsthesia on the same side below the point of section!

Even Dr. Albert Leffingwell, a writer who is comparatively reasonable in his opposition to vivisection, in a recently published pamphlet entitled "Does science need secrecy?," cites these experiments as evidence of cruelty practised in the Harvard Medical School.

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[4] Memorials and resolutions on this subject have been passed by medical and scientific societies in all parts of the world. As an example of their general purport, it will

suffice to quote the following resolution unanimously passed at the International Medical Congress held in London Aug. 9th, 1881, by twenty-four hundred of the foremost physicians of the world:—

"This Congress records its conviction: That experiments on living animals have proved of the utmost service to medicine in the past and are indispensable to its future progress; that, while strongly deprecating the infliction of unnecessary pain, it is of the opinion, alike in the interest of man and of animals, that it is not desirable to restrict competent persons in the performance of such experiments."

Though the educated physicians of the world are practically unanimous in their belief in the necessity and utility of vivisection, the antivivisectionists do not hesitate to denounce the pursuit in language of which the following extracts from letters of Col. Robert G. Ingersoll to Philip G. Peabody, Esq., published by the Illinois Antivivisection Society, may be taken as an example.

"Vivisection is the Inquisition—the Hell—of Science. All the cruelty which the human—or rather the inhuman—heart is capable of inflicting is in this one word. Below this there is no depth. This word lies like a coiled serpent at the bottom of the abyss."

"The wretches who commit these infamous crimes pretend that they are working for the good of man."

"Not one fact of importance to the human race has been ascertained by these scientific assassins."

"It is impossible to imagine an argument in favor of this barbarism, and the savagery of science. Nothing can be said in its defence."

"The vivisector is less valuable to the world than the animal he destroys."

A collection of the epithets applied by antivivisectionists to their opponents may be found on pages 18–21 of a pamphlet entitled "The utility and morality of vivisection," by G. Gore, LL.D., F.R.S., London, 1884.

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[5] In a pamphlet, entitled "Twelve Years' Trial of the Vivisection Act,—Has it stopped the scientific torture of animals in England? by M. R. C. S., London, 1889," the English law is pronounced a failure.

The Illinois Antivivisection Society prints the following statement in its various publications: "The Restrictive Act, in England, after a trial of nineteen years, has failed to restrict—according to official returns. There is no reason to doubt it would be the same in America. The seventy-four societies of the world are demanding Total Abolition."

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[6] "Vivisection, a lecture delivered in the Assembly Chamber of New York, at Albany, before a Joint Committee of both houses of the Legislature, Feb. 10, 1880," page 15. Mr. Bergh apparently intends to refer to the testimony of Dr. Robert McDonnell, given before the Royal Commission in 1876. (See Blue Book, p. 228, § 4547).

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[7] The vote passed by the Councillors June 7, 1892, and by the Society, June 8, 1892, was as follows:

Whereas, the Massachusetts Society for the Prevention of Cruelty to Animals has asked for some official action on the part of the Massachusetts Medical Society in the form of a resolution, or otherwise, as to whether in their judgment, any law and if so what law, should be enacted by our legislature to restrain or limit the practice of vivisection by physicians, medical or other students, or pupils in medical or other colleges or schools,

Therefore, *Resolved*, that the Councillors are not aware that vivisections are practised in this State in an unnecessary or cruel manner.

That the existing statutes furnish sufficient security against cruelty in vivisection as well as against cruelty in general.

That experience has shown it to be very undesirable to impose restrictions of any kind upon the advancement of medical science by the researches of properly qualified persons.

That in view of the above facts, it is, in the opinion of the Councillors, inexpedient to legislate upon this subject.

That a copy of the above preamble and resolutions be transmitted to the Massachusetts Society for the Prevention of Cruelty to Animals.

The sentiments of the Society were reaffirmed by the Councillors in the following resolution adopted June 9, 1896: —

Whereas, The Councillors of the Massachusetts Medical Society have learned, that a bill has been introduced into the Congress of the United States for the restriction of biological research in the District of Columbia,

Resolved, That a copy of the resolution adopted by the Massachusetts Medical Society in response to a communication from the Massachusetts Society for the Prevention of Cruelty to Animals on June 8, 1892, be forwarded to the Senators and Representatives of this State as an expression of the opinion of the Massachusetts Medical Society with regard to legislation on this subject, either in Massachusetts or in the District of Columbia.

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[8] London *Athenæum*, Sept. 22, 1866.

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[9] "The Vivisection Act," by the Right Hon. Robert Lowe, *Contemporary Review*, October, 1876.

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[10] The following extract from a pamphlet issued by the Society for the Abolition of Vivisection, illustrates the danger of restrictive legislation as well as the spirit in which the warfare against medical science is conducted: —

"The Beginning of The End."

"The succeeding advertisement, publishing abroad a fact so important and encouraging to the cause, and so striking a proof of the success of our crusade, was inserted in the *Morning Post* of September 13, 14, and 15, 1881; *Nature* of September 15; the *Standard* of September 15, 16, and 17; the *Athenæum* of September 17; the *Times* of September 20, 21, and 23; the *Saturday Review* of September 24; and *Galignani's Messenger* of September 19, 20, and 21.

VIVISECTION.—THE BEGINNING OF THE END. The HOME SECRETARY has REFUSED CERTIFICATES to Professor Fraser, Dr. Lauder Brunton, and Professor

Lister, for carrying on investigations which they declare to be of "the highest value to Medical Science."

GEORGE R. JESSE,
Hon. Sec. &c., Society for the Abolition of Vivisection.

Henbury, near Macclesfield, Cheshire,
10th September, 1881."

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[11] See, for example, the controversy between Miss Frances Power Cobbe and Professor Victor Horsley, *London Times*, October 17, 1892.

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[12] The New York law against cruelty to animals was enacted in 1867. While on its passage the late Dr. J. C. Dalton secured the insertion of § 10 (quoted in the text). Against this clause Mr. Bergh publicly protested and in 1880, 1881 and 1882, sought in vain to secure the enactment of a law for the total prohibition of Vivisection.

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[13] [*From the "New York Nation," November, 1879.*]

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"According to Mr. Bergh, Brown-Séquard has an exceedingly low opinion of experiments on the spinal cord; and he quotes him, in the New York *Tribune* of Sept. 26, 1874, as expressing this opinion in very plain terms. The passage is as follows:

Even Dr. Brown-Séquard himself, the very prince of experi menters, says: 'I must say that it is impossible to know, while we make a section of parts of a spinal cord, what is the precise depth of the injury; it is mere guesswork.'

Evidently, then, there can be no use in making the section. As the whole object of such an experiment is to learn what nervous endowments belong to a particular part, if we do not know what part has been reached by the section we can get from it no useful information. But why did Brown-Séquard go on making such experiments when he knew that it was impossible to learn anything from them? Perhaps he can tell us.

The above quotation is from Dr. Brown-Séquard's 'Lectures on the Physiology and Pathology of the Central Nervous System' (Philadelphia: 1860). It is to be found

on page 42 in a foot-note. Mr. Bergh gives the quotation correctly, so far as it goes. The trouble is, he does not give the whole of it. The entire passage is as follows:

I must say that it is absolutely impossible to know, *while* we make a section of parts of a spinal cord, what is the precise depth of the injury; it is mere guesswork. But if we study well the phenomena, and then, after having killed the animal, if we put the spinal cord in alcohol, we render it hard, and we can ascertain exactly what is the extent of the incision. This is the means that I always employ in my experiments, and it is also the means employed by the committee appointed by the Société de Biologie in 1855 for the investigation of my researches on the spinal cord.

So it appears that Dr. Brown-Séquard has no doubt about the exact spot reached by his incision in the spinal cord; and no one who has the opportunity of reading his original passage can have any doubt about it either. Would it be too much to say that the audacity of curtailing his language to give it an opposite sense has something about it almost ludicrous?

* * * * *

New York, Nov. 14, 1879. J. C. D."

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[14] SENATE BILL 1552.

For the further prevention of cruelty to animals in the District of Columbia.*

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That hereafter no person shall perform on a living vertebrate animal any experiment calculated to give pain to such animal, except subject to the restrictions hereinafter prescribed. Any person performing, or taking part in performing, any experiment calculated to give pain, in contravention of this Act, shall be guilty of an offense against this Act, and shall, if it be the first offense, be liable to a penalty not exceeding one hundred and fifty dollars, and if it be the second or any subsequent offense, shall be liable, at the discretion of the court by which he is tried, to a penalty not exceeding three hundred dollars, or to imprisonment for a period not exceeding six months.

* As favorably reported to the Senate May 26, 1896, by the Committee on the District of Columbia.

SEC. 2. That the following restrictions are imposed by this Act with respect to the performance on any living vertebrate animal of an experiment calculated to give pain to such animal; that is to say:

(a) The experiment must be performed with a view to the advancement by new discovery of physiological knowledge, or of knowledge which will be useful for saving or prolonging life or alleviating suffering; and

(b) The experiment must be performed by a person holding such license from the Commissioners of the District of Columbia as in this Act mentioned, or by a duly authorized officer of the Government of the United States or of the District of Columbia; and

(c) The animal must, during the whole of the experiment, be completely under the influence of ether or chloroform sufficiently to prevent the animal from feeling pain; excepting only that in so-called inoculation experiments, or tests of drugs or medicines, the animal need not be anæsthetized nor killed afterwards; nor in tests of surgical procedure need animals be kept completely anæsthetized during the process of recovery from the surgical operation. Otherwise than this, the animal must be kept from pain during all experiments; and

(d) The animal must, if the pain is likely to continue after the effect of the anæsthetic has ceased, or if any serious injury has been inflicted on the animal, be killed before it recovers from the influence of the anæsthetic which has been administered; and

(e) No experiment shall be made upon any living creature, calculated to give pain to such creature, in any of the public schools of the District of Columbia; provided as follows, that is to say:

First. Experiments may be performed under the foregoing provisions as to the use of anæsthetics by a person giving illustrations of lectures in medical schools, hospitals, or colleges, on such certificate being given as in this Act hereafter mentioned, that the proposed experiments are absolutely necessary for the due instruction of the persons to whom such lectures are given, with a view to their acquiring physiological knowledge or knowledge which will be useful to them for saving or prolonging life or alleviating suffering.

Second. The substance known as urari, or curare, shall not, for the purposes of this Act, be deemed to be an anæsthetic: and

Third. Notwithstanding anything in this Act contained, no experiment calculated to give pain shall be performed on a dog or cat, except upon such certificate being given as in this Act mentioned, stating, in addition to the statements hereinbefore required to be made in such certificate, that for reasons specified in the certificate the object of the experiment will be necessarily frustrated

unless it is performed on an animal similar in constitution and habits to a cat or dog, and no other animal is available for such experiment; and an experiment calculated to give pain shall not be performed on any horse, ass, or mule, except on such certificate being given as in this Act mentioned, that the object of the experiment will be necessarily frustrated unless it is performed on a horse, ass, or mule, and that no other animal is available for such purpose; and

Fourth. Any exhibition to the general public, whether admission be on payment of money or gratuitous, of experiments on living animals, calculated to give pain, shall be illegal.

Any person performing or aiding in performing such experiment shall be deemed to be guilty of an offense against this Act, and shall, if it be the first offense, be liable to a penalty not exceeding one hundred and fifty dollars, and if it be the second or any subsequent offense, shall be liable, at the discretion of the court by which he is tried, to a penalty not exceeding three hundred dollars or to imprisonment not exceeding six months; and any person publishing any notice of any such intended exhibition by advertisement in a newspaper, placard, or otherwise, shall be liable to a penalty not exceeding ten dollars.

A person punished for an offense under this section shall not for the same offense be punishable under any other section of this Act.

SEC. 3. That the Commissioners of the District may insert, as a condition of granting any license, a provision in such license, that the place in which any such experiment is to be performed by the licensee is to be registered in such manner as the said Commissioners may from time to time by any general or special order direct: *Provided*, That every place for the performance of experiments for the purpose of instruction shall be approved by the said Commissioners, and shall be registered in such manner as the said Commissioners may from time to time by any general or special order direct.

SEC. 4. That the Commissioners of the District, upon application as hereinafter prescribed, may license any person whom they may think qualified to hold a license to perform experiments under this Act. *Provided* only that a license shall not be granted to any person under the age of twenty-five years, unless he be a graduate from a medical college, duly authorized to practice medicine in the District of Columbia.

SEC. 5. That the Commissioners of the District may direct any person performing experiments under this Act from time to time to make reports to them of the methods employed and the results of such experiments, in such form and with such details as the said Commissioners may require.

SEC. 6. That the President of the United States shall cause

all places where experiments on living vertebrate animals are carried on in the District of Columbia to be from time to time visited and inspected without previous notice, for the purpose of securing compliance with the provisions of this Act, and to that end shall appoint four inspectors, who shall serve without compensation, and who shall have authority to visit and inspect the places aforesaid, and who shall report to the President of the United States from time to time the results of their observations therein, which shall be made public by him.

SEC. 7. That any application for a license under this Act, and for a certificate to be given as in this Act mentioned, must be signed by three physicians duly licensed to practice and actually engaged in practicing medicine in the District of Columbia, and also by a professor of physiology, medicine, anatomy, medical jurisprudence, materia medica, or surgery in the medical department of any duly established and reliable school or college in the District of Columbia: *Provided*, That when any person applying for a certificate under this Act is himself one of the persons authorized to sign such certificate, the signature of some other of such persons shall be substituted for the signature of the applicant.

A certificate under this section may be given for such time or for such series of experiments as the persons signing the certificate may think expedient.

A copy of any certificate under this section shall be forwarded by the applicant to the Commissioners of the District, but shall not be available until one week after a copy has been so forwarded.

The Commissioners of the District may at any time disallow or suspend any certificate given under this section.

SEC. 8. That the powers conferred by this Act of granting a license or giving a certificate for the performance of an experiment on living animals may be exercised by an order in writing, under the hand of any judge of a court of record having criminal jurisdiction in the District, in a case where such judge is satisfied that it is essential for the purposes of justice in a criminal case to make such experiment.

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[15] [*From "Our Dumb Animals," August, 1891.*]

"Our antivivisection friends have now been at work in Europe *some twenty years* and in America *some ten*. What have they accomplished?

In Continental Europe there has been an enormous increase of vivisection, and, so far as we can learn, *not a single case ever prevented*.

In America the same.

In England, where some laws have been enacted, *an enormous increase of vivisection.*"

* * * * *

(Signed) GEO. T. ANGELL.

[*From "Our Dumb Animals," December, 1892.*]

"It is a question in my mind whether the denunciations they (the antivivisection societies) have heaped upon the medical profession have not increased rather than diminished the practice."

* * * * *

"Stop at once all denunciation, and, in the spirit of kindness and Christianity, seek the aid of medical societies, medical schools and the medical profession."

* * * * *

(Signed) GEO. T. ANGELL.

[*From "Our Dumb Animals," April, 1896.*]

VIVISECTION AT OUR STATE HOUSE.—We have had three hearings at our State House for the purpose of obtaining a law which will permit our agents to be present and witness vivisections and experiments performed in Massachusetts on living animals.

We are opposed by the President of *Harvard University—the Massachusetts Institute of Technology—and various Colleges—the President of the Massachusetts Medical Society—various Medical Schools*, and large numbers of medical men.

* * * * *

The following was our opening address at the first hearing before *the Judiciary Committee*, on February 27th:

* * * * *

In conclusion, it is related that a newly arrived immigrant arrested for some offence and brought into one of our courts, exhibited such terror that the Clerk of the Court kindly told him "that he need not be afraid *for justice would certainly be done him*," to which he replied, "that—*that was just what he was afraid of.*"

It seems to us that any person or institution that, instead of welcoming, opposes our coming, must be in a similar condition to the person above referred to.

GEO. T. ANGELL.

[17] Extract from the stenographic report of the hearing for the petitioners Feb. 27, 1896. Cross-examination of Mr. Angell by counsel for remonstrants:

Q. This bill is promoted by your Society or yourself?

A. By the Society, of course.

Q. Has the Society taken any action in regard to this bill?

A. It has been brought before our directors.

Q. Did they pass a vote in regard to it?

A. I guess so. How was that, Mr. Hill?

Mr. Hill. The bill was proposed with their acceptance.

Q. And there was formal action taken?

Mr. Hill. We have not the record here, so I could not tell you that.

* * * * *

Q. [*To Mr. Angell*]. How many directors are there?

A. Twenty-four, I think.

Q. How many were present at that meeting, where the matter was brought up?

A. Seven or eight, it is my impression.

Q. You don't remember whether any formal action was taken?

A. It came a very stormy day and I think not more than seven or eight were present.

Q. Yourself and Mr. Hill and five others?

A. I think so.

Q. You don't remember whether any formal action was taken?

A. No, but the President has authority to take charge of the work of the Society.

Q. Then the specific thing which is done here is done under your general authority as President.

A. Very largely. Yes, sir.

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[18] Bill presented by the Society with its successive modifications.

AN ACT RELATING TO VIVISECTION IN SCHOOLS.

(HOUSE 548.)

Be it enacted, etc.

Section 1. No vivisection of any dog, cat, or other warm blooded animal shall be practised or permitted in any school, except regularly incorporated universities, colleges and medical schools.

Sec. 2. No experiment upon any live animal, which subjects such animal to pain, shall be performed or permitted in any school or educational institution, except for the purpose of relieving such animal from suffering, unless such experiment shall be authorized by a permit from the state board of health, specifying the object thereof, and the number and kind of animals to be subjected thereto. Said board shall keep a record of each permit so granted, which shall be open to public inspection.

Sec. 3. Any agent of the Massachusetts Society for the Prevention of Cruelty to Animals may be present at any experiment designated in this act, and shall at all times be permitted to witness the same; and the time and place of any such experiment shall, upon the request of such agent, be made known to him.

Sec. 4. Whoever violates any provision of this act shall be punished by a fine of not less than twenty dollars, nor more than one hundred dollars; and all fines collected upon or resulting from prosecutions under this act shall be paid to the Massachusetts Society for the Prevention of Cruelty to Animals, in aid of the benevolent work for which said society was incoporated.

Sec. 5. This act shall take effect upon its passage.

AN ACT RELATING TO VIVISECTION IN SCHOOLS.

Be it enacted, etc.

Section 1. Any agent or agents of the *Massachusetts Society for the Prevention of Cruelty to Animals* may be present at any experiment on or dissection of any live animal in any school or educational institution in this Commonwealth, and shall be permitted to witness the same; and the time and place of any such experiment or dissection shall, upon the request of any such agent, be made known to him by the person having charge of such experiment or dissection.

Sec. 2. Whoever violates this act by preventing any such agent from being present or failing to give such agent information when requested as above provided, shall be punished by a fine of not less than twenty dollars nor more than one hundred dollars.

AN ACT RELATING TO VIVISECTION IN SCHOOLS.

Section 1. Agents of the Massachusetts Society for the Prevention of Cruelty to Animals, especially designated for the purpose by the Board of Directors of the said Society, may be present at any experiment on or dissection of any live animal in any school or educational institution in this Commonwealth, and shall be permitted to witness the same; and the time and place of any such experiment or dissection shall, upon the request of any such agent, be made known to him by the person having charge of such experiment or dissection.

Provided that not more than twenty persons shall be so designated, and that no person shall be so designated who has not received a degree of Doctor of Medicine from a legally chartered medical college or university having power to confer degrees in medicine in this Commonwealth.

Sec. 2. Whoever violates this act by preventing any such agent trom being present or failing to give any such agent information when requested as above provided, shall be punished by a fine not less than twenty dollars nor more than one hundred dollars.

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[19] See "O-Kee-Pa. A religious ceremony and other Customs of the Mandans," by George Catlin. London, 1867.

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[20] Brunton (Pharmacology and Therapeutics, page 92) quotes and confirms Schiff's observation, "that the sensory nerves have their conducting power destroyed by curare, but that they are less affected and after a longer interval than the motor nerves."

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[21] *Fortnightly Review*, March, 1882.

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[22] Harvey's own words are: "Multa frequenter et varia animalia viva introspiciendo." The translation in the text is therefore more literal than that given in the English edition of Harvey's works, published by the Sydenham Society, which reads as follows: "having frequent recourse to vivisections, employing a variety of animals for the purpose."

Notwithstanding this direct testimony of Harvey himself, we constantly find in antivivisectionist literature the statement that the discovery of the circulation of the blood was not made by means of vivisections. Thus Lawson Tait, in his pamphlet "On the usefulness of Vivisection upon Animals as a method of Scientific research," writes "That he (Harvey) made any solid contribution to the facts of the case by vivisection is conclusively disproved, and this was practically admitted before the Royal Commission by such good authorities as Dr. Acland and Dr. Lauder Brunton." A complete refutation of both of these statements may be

found on p. 136 and p. 146 of the work on "Physiological Cruelty" already alluded to.

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[23] See "Physiological Cruelty," p. 70.

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[24] Extract from an article on "The treatment of Diphtheria by Antitoxin," by Wm. H. Welch, M.D.: —

[*From "Johns Hopkins Hospital Bulletin," July-August, 1895.*]

"The discovery of the healing serum is entirely the result of laboratory work. It is an outcome of the studies of immunity. In no sense was the discovery an accidental one. Every step leading to it can be traced, and every step was taken with a definite problem.

"These studies and the resulting discoveries mark an epoch in the history of medicine. It should be forcibly brought home to those whose philozoic sentiments outweigh sentiments of true philanthropy, that these discoveries which have led to the saving of untold thousands of human lives have been gained by the sacrifice of the lives of thousands of animals and by no possibility could have been made without experimentation upon animals."

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[25] Public Health Reports, II., p. 595.

ARTICLE II.

THE SHATTUCK LECTURE.

GANGRENE AS A COMPLICATION AND SEQUEL OF THE CONTINUED FEVERS, ESPECIALLY OF TYPHOID.

By WILLIAM W. KEEN, M.D.
OF PHILADELPHIA, PA.

DELIVERED JUNE 9, 1896.

GANGRENE AS A COMPLICATION AND SEQUEL OF THE CONTINUED FEVERS,

ESPECIALLY OF TYPHOID.

Mr. President and Members of the Massachusetts Medical Society: — It is first of all my pleasant duty most cordially to thank you for honoring a stranger by electing him to deliver the Shattuck Lecture for 1896. Yet I am not a stranger in the old Bay State, for I see around me many esteemed former pupils and many men who honor me with their friendship. Even were this not so, do we not all belong to one common guild united by one common impulse, the relief of human suffering and the prolongation of human life — a guild which, God be thanked, knows no dividing lines of State or nation, creed or color, but all around this goodly earth is marching on, hand clasped in hand, in its heavenly mission of healing?

When I received the invitation, in casting about for a subject, it occurred to me that it would be just twenty years since I delivered the fifth Toner Lecture on "The Complications and Sequels of the Continued Fevers," which required a sequel, a sort of "*Vingt ans après.*" That lecture for the first time gathered together the many isolated cases reported in the previous thirty years and systematized our knowledge of the surgical relations of typhoid fever. The twenty years that have elapsed since its delivery have rendered some of its pathology quite obsolete, especially by the discovery in 1880 by Eberth of the bacillus of typhoid; but

the clinical facts and deductions there set forth are as true to-day as they were then; and that typhoid and other continued fevers have important surgical relations is now well recognized by the profession.

It was my intention at first to consider in this, as in that, lecture all the surgical relations of typhoid; but when my intelligent and industrious friend, Dr. Thompson S. Westcott, of Philadelphia, who kindly consented to tabulate all the recorded cases of such complications and sequels since 1876, brought to me a harvest of between seven and eight hundred cases, I found that it would be quite impossible to review them all within the limits of a single lecture.

These, with the 433 included in the former lecture, make a total of nearly 1,200 cases (besides 352 cases of parotitis not included in the general summary in the first lecture, for they chiefly followed typhus), by far the largest and most complete table ever published. They practically cover the reported cases of the last fifty years.

I would neglect another pleasant privilege, as well as duty, were I not to acknowledge the repeated courtesy and broad-minded liberality of the officers of the Library of the Surgeon-General's Office of the United States Army, for the important aid they have rendered me in placing the treasures of their unrivalled collection at my disposal for frequent consultation, without which, this extensive tabulation would have been absolutely impossible.

The bone lesions following typhoid have been more or less prominently considered of late, especially by Parsons of Johns Hopkins in this country.* Gangrene as a complication or sequel, however, is less frequent, and also less well known; and I purpose, therefore, in the present lecture to consider it alone. The many other complications of typhoid I hope to take up in a monograph, which I shall

* Johns Hopkins Hospital Reports, Vol. v., 1895, 417; and Annals of Surgery, November, 1895, 623.

publish hereafter, which will include both my Toner and the present Shattuck lectures, with the tables of all the cases gathered together by Dr. Westcott, with observations and deductions as to their symptoms, pathology and treatment.

English and American authors in the past have not given the attention to gangrene after typhoid which its importance deserves. Thus Reynolds and Bartholow make no allusion to it; Wilson only alludes to gangrene of the lung and the mouth, two of its rarer sequels; Flint mentions it, but had never seen a case; while Murchison in his classical work and Hutchinson in an excellent chapter on typhoid in "Pepper's System of Medicine" give it only a brief notice. Nor have the surgeons done it any better justice. Neither Gross, Agnew, Ashhurst nor Holmes ("System of Surgery") mention it. Barwell, in the "International Encyclopædia of Surgery," refers to it briefly.

We owe our chief knowledge of the subject to French authors, and to a few recent German and American publications. Larrey,* Hildebrand,† Alibert,‡ and Fabre§ mention sporadic cases of gangrene; but attention was first seriously called to its occurrence in typhoid fever in 1857 by Bourgeois‖ and Bourguet.¶ The next papers of any importance were by Gigon in 1861 and 1863.** The former established the fact of gangrene from arterial obstruction by autopsy, though he regarded the gangrene as a coincidence rather than a consequence of the fever. In 1863, Patry†† confirmed these earlier observations. The cases reported by these authors were included in the summary published in the Toner Lecture already alluded to.

* Mém. et Campagnes, iii., 72.
† Typhus Contagieux, 1806.
‡ Thèse de Paris, 1838.
§ Gaz. Méd. de Paris, 1851, 539.
‖ Bull. Soc. Méd. des Hôp., Paris, iii, 311.
¶ Gaz. Hebd., 1867, 646.
** L'Union Médicale.
†† Arch. Gén., 1863, i., 129.

Since my own contribution, some of the more important papers are those of Spillman,* Gaston David,† Barié,‡ Deschamps,§ Haushalter,‖ Flexner,¶ and Quervain,** beside a very large number of individual cases, which have been reported by various authors.

One would suppose *a priori* that gangrene would only follow severe attacks, but so large a number of cases of gangrene have been reported after relatively mild attacks that we must concede the possibility of gangrene in mild cases as well as severe ones. Hence, the watchfulness of the physician should never relax by reason of the fact that the case is running a mild course and that gangrene is an infrequent result of typhoid.

Following the example of my Toner Lecture, Dr Westcott has included in his table a few cases of typhus and other continued fevers, as well as of typhoid. The vast majority, however, are cases of typhoid, much more so than appears in the statistical numbers, for by "typhus" is often meant "typhus abdominalis," especially in the cases of my first series. The other cases, therefore, do not materially affect the conclusions reached, and any one who desires to do so can separate those of typhoid from the remainder by referring to the table when published. Owing to the great preponderance of typhoid, I have often in the text used the word "typhoid" as a single descriptive word rather than the cumbersome, though more accurate phrase "the continued fevers, especially typhoid."

While gangrene is an important complication or sequel

* Arch. Gén. 1881, 7th, s., vi., 150.

† La Gangrene Typhoide, Thèse de Paris, 1883.

‡ Rev. de Méd., 1884, No. 1.

§ Thèse de Paris, 1886.

‖ Merc. Méd., September 20, 1893, 453.

¶ Johns Hopkins Hospital Reports, November, 1894, 120; and Journal of Pathology and Bacteriology, November, 1894, iii., 202.

** Centralbl. f. inner. Med., August 17, 1895.

of typhoid, it is fortunately rare, so that most practitioners, even men of vast experience in large hospitals, have never seen a case; for example, Flint and Murchison. Hölscher,* in 2,000 fatal cases of typhoid, does not report a single case, though he records 59 cases of thrombosis of the femoral vein and Bettke,† in 1,420 cases found only four cases of gangrene, all limited to the toes. In my former lecture I tabulated 43 cases from typhoid and 56 from typhus.‡ Since 1876, Dr. Westcott has found 90 cases of actual gangrene, in addition to which he has tabulated 21 cases of arterial and 48 of venous thrombosis not followed by gangrene. In its infrequency, therefore, it is in marked contrast to the bone lesions, of which he has found 168 cases, all after typhoid; to which from my former lecture are to be added 37 after typhoid and four after typhus, or a total in typhoid alone of 205 cases of bone lesions to 133 of gangrene.

Date of Onset.—While gangrene is generally a late complication during the course of the fever, or an early sequel during convalescence, it is never a very late sequel, as is the case in the bone lesions. The latter often do not occur till several weeks, sometimes months and occasionally even years after the attack of fever. This is doubtless due to the fact that the bacilli of typhoid find a favorable nidus in the bones, especially in the marrow, and have been repeatedly demonstrated by stain and culture after six, twelve or eighteen months, and even after so extraordinary long a period as six or seven years.[3] In addition to this, the slowness of all pathological processes in

* Münch. med. Woch., 1891, xxxviii., 43.

† Inaug. Diss., Basel, 1870.

‡ Thirty-four of these after typhus were reported by Estlander (Langenlick's Archiv, 1870, p. 453) in a frightful epidemic following a financial crisis and a series of bad harvests in 1862–7, in Finland.

§ Sultan: Deutsch. med. Woch., 1894, 675. Buschke: Fortschritte d. Med., 1894, 573.

the hard osseous tissues, as contrasted with their rapidity in the soft parts, would naturally lead us to expect that gangrene would occur far earlier than lesions in the osseous tissues.

The earliest time at which gangrene occurred, I find, is on the fourteenth day, and the latest in the seventh week. By far the commonest time for this dangerous complication to appear is the second and third weeks, during which 39.2 per cent. of all the cases occurred.

The causes for the appearance of gangrene in the second or third weeks, or later rather than early in the disease, are probably twofold. First, during the earlier stages of the disease, the general vitality of the patient and the resistance of the tissues are such that they can combat successfully the evil tendencies of the fever; but, secondly and chiefly, just as for the production of the intestinal lesions, so for the gangrene, a certain length of time is required for the diffusion of the bacilli and their toxic products, and for their resulting evil effects. Both causes unite in working together and to the same end. By the second or the third week, the bacilli and their toxic products have become diffused through the system; excessive feebleness has followed the small amount of food taken and the exhaustion from the continued high temperature;* the heart has become weakened and favors the formation of thrombi, not only in the heart but also in the vessels, either as a result of arteritis or of autochthonous thrombosis; emboli frequently result; and with the sluggish circulation, the general enfeeblement both of mind and body, and the frequently obstructed vessels, the advent of gangrene at this period of the fever should occasion no surprise. Indeed, the surprise is rather that it is so rare.

* We do not appreciate how much a continued high temperature alone exhausts a patient. Were the body composed of water alone, to raise the temperature of a person weighing 150 pounds from 98.5° to 103.5°, *i. e.* five degrees (to say nothing of the expenditure of force needful to keep it there), requires an expenditure of force equal to raising 285 tons one foot (150×5 ×772 foot pounds). A girl of 100 pounds weight, simply lying still in bed, suffering from such a fever, does daily the work of two or three men.

Let us now consider the pathology, symptomatology and treatment.

I. PATHOLOGY.

Various writers have been the partisans of one or another single cause for the occurrence of gangrene during and after typhoid fever. This seems to me an error, for, as I hope to show, there are a number of causes, of which one will exist in one case and another in another case; sometimes singly, sometimes in combination.

In my former lecture, I was disposed to regard the causes of gangrene as chiefly three: first, the altered blood; secondly, the weakened heart; and, thirdly, the mechanical difficulties in carrying on the circulation, especially in distant parts; and that all of these caused the gangrene by the production of thrombi either macro- or micro-scopic. Since that lecture was delivered, however, the bacillus of typhoid has been discovered, and has been proved by a very few careful examinations to play an important, and in some cases at least a direct rôle in the production of gangrene. It is greatly to be regretted that but very few cases have been studied with the scientific precision which they deserve. By calling renewed attention to the subject, however, I hope to stimulate others, especially in this country, to make thorough bacteriological examinations in the future. All the more are such careful examinations necessary, since the opportunities to make them are so rare, and when they do occur it is only too seldom that they fall into the hands of men with the opportunities and the capabilities for making such examinations.

The parts which should especially be examined bacteriologically are, first, the endocardium; secondly, the endocardial clots; thirdly, the walls of the arteries and of the veins at the point where they are obstructed by thrombi or emboli; fourthly, the thrombi or emboli themselves;

fifthly, the perivascular tissues in the same neighborhood; and, finally, if there are no visible coagula, then the gangrenous tissues themselves should be examined.

In two cases in my table, ergot had been freely given in consequence of hemorrhage. Were these the only cases of gangrene, one might suppose that this had had a determining influence, but as gangrene followed in 88 other cases, in none of which was this drug administered, its exhibition must be considered as merely incidental.

As a foundation for our study of the pathology of typhoid gangrene, let me recall a few of the facts which have been demonstrated bacteriologically.

First, not a few cases of typhoid fever suffer from a mixed infection. This is much more apt to lead, however, to other disorders than gangrene. For example, as I shall show hereafter, there have been a number of cases of tetanus, of erysipelas and of malignant pustule, due, of course, to a mixed infection of the typhoid and these specific bacteria. In addition to that, the large number of cases of suppurative disorders in various organs, bones, spleen, muscles, etc., presume the presence of the ordinary pyogenic bacteria, and their presence has been proved by stain and culture. In two cases in my table, pyemia or septicemia, a rare condition is noted. One by Wagner* commenced with a crural phlebitis relatively early in the disease (the ninth day), death occurring from pyemia on the eighteenth day. In another reported by Spillman,† gangrene of the lips occurred, probably from carious teeth, and the patient died from staphylococcus septicemia, the aureus being found in the spleen, kidneys and liver. They had probably obtained entrance from the mouth. That mixed infection should occur in typhoid fever is not at all remarkable, since the intestinal ulcers and, in a large minority of the cases

* Briefly mentioned in the British Medical Journal, 1891, i., 18.

† Merc. Méd. 1895, No. 13, 145.

also, the ulceration of the mucous membrane of the mouth, and the bed-sores which are so frequent in typhoid afford favorable ports of entry.

The researches of Vincent* are very noteworthy in this respect, especially as to mixed infection by the streptococcus. In mixed cultures of the bacillus of Eberth and the staphylococcus or the streptococcus, the greatest difference is observed in the influence of these two pyogenic organisms on the bacillus of typhoid. The staphylococcus is remarkably inimical to the growth of the bacillus of typhoid, so that the latter soon disappears, while, on the contrary, when mixed with the streptococcus the typhoid bacillus grows vigorously. In his experimental researches he found that doses of the streptococcus or of the bacillus of typhoid, neither of which was fatal if injected singly, if injected together would produce the most violent reaction and death.

In 41 cases of typhoid in which various suppurative processes occurred, in 32 the complication was due to the aureus or albus. All of these recovered in spite of extensive suppuration and multiple periostitis. On the other hand, of eight cases in which the streptococcus either alone or associated with the bacillus of Eberth was found, five died, showing a striking difference in the fatality of the mixed infection by these two pyogenic organisms. Sänger† also found the streptococcus in the vegetations of typhoid endocarditis.

Turning now to the cases in which bacteriological examinations have shown pure cultures of the bacillus of Eberth, we must note that they may be found (*a*) in the blood, (*b*) in the endocardium, (*c*) in the walls of the arteries, (*d*) in the walls of the veins, (*e*) in the thrombi, and (*f*) in the perivascular tissues.

* Annales de l'Institut Pasteur, 1893, vol. vii., 141.

† Deutsch. med. Woch., 1886, iv.

(*a*) Typhoid Bacillus in the Blood. The bacilli of typhoid are most numerous in the blood in the first twelve days of the disease. From then till the end of the third week they diminish rapidly, and during the fifth and sixth weeks are only found exceptionally (Park). It is probable that they reach the blood by the lymphatics, since they are found in abundance in the thoracic duct.* That they must be distributed by the blood (though so rarely actually found there) is made probable also by the fact that occasionally they are found in multiple organs of the body which could only be reached through the circulation. This is strikingly shown in the remarkably well studied cases of Flexner† in which he found them in the mesenteric glands, the spleen, the liver, the bile, the kidneys, the lungs, the marrow of the bone and in the blood of the heart. In the kidneys were a large number of abscesses resembling miliary tubercle, which, however, were proved to be real abcesses containing the bacillus of typhoid in pure culture.

Vincent also, in the paper alluded to, gives details of six cases in which they were found in the blood, the spleen, the liver, the mesenteric glands, the brain, the spinal cord, the cerebro-spinal fluid, the kidneys and the lungs. Moreover, the fact that in several cases they have been found in the fetus proves without possibility of question their transmission by the blood.‡

(*b*) In the Endocardium. Viti§ not only found the bacillus of Eberth in the granulations of endocarditis, but by the injections of the bacillus only into rabbits he was able to produce endocarditis with vegetations.

* Déhu: Le rôle du bacille d'Eberth dans les complications de la fièvre typhoide, Thèse de Paris, 1893, p. 59.

† Loc. cit.

‡ Freund and Lovy: Berl. klin. Woch., 1895, No. 25. Chantemesse and Widal: Gaz. Hebdom. March 4, 1887, 146. For other references see Flexner's paper.

§ Atti della R. Accademia del Fisiocritici di Siena, 4 s., vol. ii., fasc. 5, 6, 1890.

Vincent* records another case of a soldier who was undoubtedly free from the preceding endocarditis, but died from typhoid and in the vegetations on the mitral valve pure cultures of the bacillus of Eberth were found. Girode† made a similar observation. Gilbert and Lion‡ were also able to produce such endocardial vegetations experimentally.

Besides the actual discovery of the bacillus of Eberth in the endocardial vegetations, it is not uncommon to find ante-mortem clots in the cavities of the heart. Forgues,§ Beaumanoir,‖ Fritz,¶ and Vallette (quoted by Ferrand), have all recorded such post-mortem findings. These clots are formed probably during the period of cardiac weakness, especially in the second and third weeks,** and, as the heart begins to regain its force and lose its frequency, are washed into the circulation as emboli. In the viscera their presence is shown by multiple infarcts; in the legs by the occurrence of gangrene.

(*c*) In the Walls of the Arteries. Rattoné†† reports four cases in which, in section of the arterial tunics, he was able to obtain pure cultures of the bacillus of typhoid.

(*d*) In the Walls of the Veins. Haushalter‡‡ found the bacillus in the sections through the veins; and both he and Vaques found the pyogenic microbes in the vein walls in cases of typhoid phlegmasia.

Arteritis, endarteritis and peri-arteritis, phlebitis and periphlebitis have been described by a number of authors, especially Ferrand, Deschamps, Mettler, Barié, Quervain and Haushalter. With the exception of the last two, the

* Merc. Méd., February 17, 1892, 73.
† Comptes Rendus Soc. Biol., 1889, 622.
‡ Comptes Rendus, 1889.
§ Réc. de Mém. de Méd. Militaires, 1880, 3d s., xxxvi., 386.
‖ Prog. Méd., 1881, ix., 364.
¶ Charité Annalen, vi., 169.
** Drewitt: Lancet, 1890, ii., 1023.
†† Della Arterite Tifosa in Déhu, loc. cit.
‡‡ Merc. Méd., September 20, 1893, 453.

descriptions are pathological, but without bacteriological confirmation. Ferrand quotes numerous cases of endarteritis of the iliac, femoral and popliteal arteries followed by thrombosis and gangrene. Barié describes two forms of arteritis; first, an obliterating form, and, secondly, a parietal. In the first there is profound alteration of the middle coat, the muscular fibre cells being infiltrated with embryonic cells, with sclerosis of the external coat and vegetations in the lumen. Sometimes, indeed, the three coats are indistinguishable. In others the lining membrance is covered with small elevations consisting of masses of round and fusiform cells. There is a loss of elasticity in the vascular walls, which become friable and easily distended. The loss of smoothness of the intima, the irregularities of its surface and the diminished calibre from the swelling are readily conceived causes for the formation of thrombi resulting frequently in gangrene. The thormbi at first red, but later decolorized, become adherent to the wall, and finally the artery becomes a solid cord. The secondary thrombosis is slow. The calibre is gradually oliterated, and the gangrene, therefore, is correspondingly slow and not sudden as in embolism; but from the original thrombi secondary emboli may form, and so hasten the gangrene by obliteration of the anastomotic circulation. As a rule, therefore, in arterial thrombosis the gangrene is *dry*, but occasionally during the course of the dry gangrene from arterial obstruction, the vein becomes obstructed and part or all of the limb may fall into sudden ruin from moist gangrene.

The parietal arteritis, according to Barié, is not attended with thrombosis, and is usually followed by recovery.

That arteritis should occur in typhoid is rendered also probable by its appearance in other allied specific diseases, such as small-pox, diphtheria, tuberculosis, syphilis, rheumatism, etc.

How the bacilli reach the walls of an artery or vein is a

question. Ordinarily they are not found in the blood; and yet the fact that they may be so widely distributed throughout the body, and that the only reasonable mode of such an extensive diffusion is by the blood, the cases of Flexner, Vincent and others amply prove. Haushalter believes that during their maximum they may reach the vessels by the vasa vasorum,* which, it must be remembered, especially in the veins, reach the middle and often the internal coat. He is inclined, however, to believe that the process is as follows: that an infection of the pelvic or crural ganglia occurs, followed by an infection of the perivenous cellular tissue by retrograde lymphatic circulation. In these cases, he supposes that a periphlebitis exists, followed by a secondary endophlebitis precipating a thrombus by the ferment furnished by the bacilli. This, I confess, seems to me much less likely than the former view.

(*e*) In the Thrombi. Both Rattone and Haushalter found the bacillus of typhoid in thrombi. The latter calls attention to the fact that he was not able to stain them in the thrombus, due, he thinks, to the fibrin, which being decolorized with great difficulty, probably obscured the bacilli; but he was able to demonstrate their presence by cultures. He found the endothelium of the veins destroyed. On the surface of the clot next the vein wall a layer of leucocytes was intimately united both to the clot and the wall of the vein. The typhoid bacillus existed only in the thrombosed portion of the vessels; and he is of the opinion that either the bacilli or their products caused the destruction of the endothelium and the resulting clot, and that in all probability in the products of the bacilli was found the ferment necessary to produce the coagulation.

(*f*) In the Perivascular Tissue. Quervain found the bacillus in pure culture in the pus surrounding the popliteal

* For a number of cases in which bacteria were found in the vasa vasorum, see Lockwood "Traumatic Infection," London, 1896.

artery and vein. That the bacillus should exist in the pus and in pure culture ought not now to astonish us.

The pyogenic power of the typhoid bacilli has been very generally doubted in the past; but, as I shall show hereafter, in connection especially with the bone lesions of typhoid, the bacilli have been so frequently found in pure culture, in abscesses, periostitis, osteomyelitis and other purulent conditions, that we can no longer doubt their occasional pyogenic function. If any additional proof were needed, the experimental researches of Orloff,* Colzi,† and later especially by Dmochowski and Janowski,‡ and by Flexner in the paper already alluded to, would dispel any lingering doubt. In Flexner's case, having in mind the objections of E. Fraenkel and Baumgarten, and especially the alleged difficulty of distinguishing between the typhoid bacillus and the colon bacillus, and the belief that all of the abscesses asserted to be from the typhoid bacillus were really the results of mixed infection of the typhoid bacillus and the ordinary pyogenic bacteria, special attention was paid to their differentiation. Inasmuch as the commonest pyogenic organism, the staphylococcus, has a greater vitality and is more persistent than the typhoid bacillus (cf. p. 67), so that the latter would die out before the former, it is reasonable to conclude that when the typhoid bacilli are found in pure culture in an abscess, they must have been its pathological cause.

Why in some conditions the typhoid bacillus should be pyogenic, and in others not, we can only at present speculate. No reason can be alleged. But we are precisely in the same position as to the pyogenic function of other bacilli, for example the colon bacillus, which we certainly know to be a possible, and one might almost say a frequent cause

* Wratsch, No. 49, 1889, and Nos. 4, 5 and 6, 1890.

† Lo Sperimentale, 1890, lxv., 623.

‡ Ziegler's Beiträge Path. Anat. ü Allgemein Pathol., 1895, xvii., 221.

of suppuration in certain conditions (for example, appendicitis), whereas ordinarily it is an entirely harmless intestinal organism. The care taken by Flexner and Dmochowski and Janowski, Haushalter and Quervain to distinguish the two bacilli by their various stains and different reactions are so manifold that the differentiation of the two may be regarded in these cases as complete.

Having now determined the bacteriological facts, let us see how they may be applied pathologically in explaining the causation of gangrene.

The cause of gangrene may be stated in practically a single phrase, *obstruction to the circulation*. The three factors I have already quoted from my first lecture, the altered blood, the weakened heart, and the mechanical difficulties of the circulation in distant parts, especially the last two, still hold good, but there must be added to them the important rôle of the typhoid bacillus in assisting, and often it may be in directly precipitating the coagulation of the blood, which is the cause of the obstruction. Four different varieties of obstruction, therefore, may exist and sometimes co-exist: first, arterial emboli of cardiac origin; secondly, autochthonous thrombi in the arteries; thirdly, autochthonous thrombi in the veins; and, fourthly—probably, though I believe there has been no cases absolutely demonstrated pathologically—thrombi in the peripheral vessels.

(1) Arterial Embolism of Cardiac Origin. This has been observed not only at post-mortems, but clinically. Thus Hayem* observed the alterations of the heart two days before gangrene of both legs commenced; the first symptoms being acute pain in the legs with a sensation of cold. The pulsation first in the dorsalis pedis, then in the popliteal, then in the femoral disappeared. Amputation showed that though the arterial walls appeared to be healthy, the femoral artery was partly obstructed by a clot. The obstruction

* Prog. Méd., 1875.

being only partial allowed a feeble circulation to go on. The popliteal and all its branches below the inferior articular were entirely free from any clot. The patient died, and the autopsy showed endocarditis and clots in the heart, the aorta obstructed by a clot extending from its bifurcation to a point above the origin of the inferior mesenteric, but the iliac arteries were entirely free. The spleen and the kidneys presented multiple infarcts. Mercier* reports also a case of dry gangrene of both legs with fibrinous clots in both the primitive iliacs, deep femoral and popliteal, the walls of which were healthy, and in the left auricle where there were old fibrinous clots with endocarditis. This form of arterial obstruction is quite common in my table, as will be observed in the *résumé* on page 79. It leads, as would naturally be supposed, almost always to dry gangrene, because it cuts off the supply of blood, as a rule, absolutely, though in a few cases, as in the one quoted from Hayem, a small amount of blood may still reach the distal parts and so restrict the extent of the gangrene. The very fact also that the walls of the arteries were healthy and that there were multiple infarcts in the viscera, all testify to the cardiac origin of such emboli.

(2) Arterial Thrombosis. In a great number of cases in the table, there were no evidences of preceding cardiac disease, and yet obstructive clots were found in the arteries, and were followed by dry gangrene. These are undoubtedly autochthonous thrombi probably produced largely from the ferment furnished by the bacilli themselves or possibly more frequently from an endarteritis, such as has been already described. The consequences of the thrombosis, as of the embolism of the arteries, will be a greater or less degree of dry gangrene, the extent of which will depend upon the completeness or incompleteness of the obstruction.

* Arch. Gén., 7th s., 1878, vol. ii., 402.

(3) Venous Thrombosis. This is much more frequent than the arterial form, probably from the more sluggish circulation, in addition to the infectious processes which undoubtedly sometimes cause a phlebitis or a peri-phlebitis. It results in gangrene in a moderate number of cases, but in the majority, as in venous thrombosis from puerperal fever, pneumonia, etc., gangrene is much less apt to follow venous than arterial thrombosis. The circulation is not nearly so completely cut off by venous obstruction as by arterial, since the collateral venous channels are less frequently blocked. Moreover, in arterial obstruction, the limb below the obstruction is entirely deprived of blood, whereas in venous obstruction the blood is dammed up in the part beyond the obstruction. The circulation may be hindered, but if it be not practically entirely arrested, a feeble nourishment goes on, sufficient at least to prevent gangrene.

It is to be observed that both in venous and arterial thrombosis, especially the latter, the clots are often discontinuous. (See cases of Hayem, Mercier and Beaumanoir.) This possibly may be due to isolated spots of local infection from the bacilli.

The venous clots are often very extensive, much more so than the arterial, as shown by a number of cases in my table. Thus, in a case of De Santi,* the clot extended downward to the deep femoral vein and upward through the common iliac to the vena cava. Beaumanoir† reports not only clots in the arteries of both legs, but also fibrinous clots in the right ventricle and pulmonary artery and its branches, in the left auricle and in the femoral arteries and veins and in the aorta to the level of the first intercostal artery. Naturally such extensive obstruction was followed by gangrene of both lower extremities. Clots ex-

* Rec. de Mém. de Méd. Militaires, 3d s. vol. xxxv., 1879, 502.

† Prog. Méd., 1891, ix., 364.

tending into the vena cava are also reported by Dumontpallier,* Sorel† and Bouley.‡

Occasionally, as would be supposed, venous thrombosis is followed by sudden death, as in a case reported by Nauwerck§ of thrombosis of the left iliac vein, which was followed by sudden embolism of the pulmonary artery while the patient was at stool, and death in ten minutes, and in another reported by Bourlet‖ also of thrombosis of the external iliac vein, which extended to the inferior vena cava and the right auricle of the heart, and the patient died from syncope. As would naturally be supposed also, the thrombosis, both arterial and venous, but especially the former, is apt to lead not only frequently to double gangrene, for example, of both lower extremities, but sometimes to a gangrene which is so symmetrical as to remind one of cases of Raynaud's disease.

When the gangrene results from venous obstruction rather than arterial, the gangrene is, as a rule, *moist*. Not uncommonly thrombosis of the arteries and veins is either successive or simultaneous. In either case, the gangrene is apt to be a combination of dry and moist gangrene. Occasionally when the venous thrombosis follows the arterial, the gangrene will be at first of the dry variety in the distal parts and when the venous obstruction occurs, moist gangrene will follow in the proximal.

(4) Thrombosis in the Peripheral Vessels. In addition to the three forms above recited, there are a number of cases reported in which the disease began as dry gangrene in the toes and gradually crept up the leg. The persistence of pulsation in the dorsalis pedis and other higher arteries showed that there was no arterial thrombosis or embolism

* Comptes Rendus Soc. Biol., 1879, 6th s., vol. iv., pt. 2, 3.
† L'Union Méd., 1882, 3d s., vol. xxxiv., 521.
‡ Prog. Méd., 1880, viii., 998.
§ Corresp.-blatt Schweizeraerzte, 1879, 485.
‖ Prog. Méd., 1880, viii., 988.

in the arteries higher up, but after a time the coagulation, which had begun in the periphery, extended centrally, and first the dorsalis pedis, then the tibials at the ankle, and later the popliteal and even the femoral were successively obstructed, resulting, of course, in a more widespread gangrene. The symptoms show that none of the three preceding conditions existed, but they enable us by analogy to reach the conclusion that spontaneous thrombi formed in the distal vessels. Whether the cause of this thrombosis is a bacillary infection or not has not been studied with that care which it deserves, and no absolute pathological or bacteriological confirmation of this view, I believe, has been reported.

II. SYMPTOMS OF GANGRENE.

The symptoms of gangrene are marked and characteristic.* Let us suppose the case to be one of arterial embolism or thrombus. Towards the end of the fever, especially in the third week or early in convalescence, as weakness is giving place to strength and the brightest hopes of speedy recovery are cherished, sudden, severe and persistent pain is felt. This may be at the seat of the impending gangrene, though perhaps more commonly it is in the obstructed artery, especially in the femoral, popliteal or tibial, and radiates thence to the periphery. It is followed by numbness, coldness, loss of sensation, and sometimes of motion, and in a short time discoloration and all the other usual evidences of gangrene appear. Sometimes, but not usually, these local symptoms precede the pain. If the vessels of the foot or at the ankle, or even the popliteal, be examined, the pulsation will be found feeble or utterly extinguished, while higher up at the seat of the obstruction the artery will be changed into a moderately firm but very tender cord, in which we may some-

* Partly quoted from my Toner Lecture.

times differentiate the obstructed artery from the non-obstructed vein — an important point in prognosis. Week by week, sometimes day by day, the growth of the secondary coagulum may be traced upwards by the progressive abolition of the arterial pulsation and by the upward march of the gangrene. If old cicatrices from burns, or unhealed eczematous ulcers, old fractures or varicose veins exist, all *loci minoris resistentiæ*, they will be among the earliest parts to yield. Blebs may form in the early stages, but most frequently they will dry up and the parts will mummify, although, as already indicated, moist gangrene may supervene if a large clot form much higher up, or if, in addition to the artery, the vein also becomes extensively obliterated, thus involving great masses of moist tissue, such as the thigh, in sudden ruin.

As is generally seen in cases of dry gangrene, days or weeks will elapse, if the patient lives so long, during which nature as usual makes a powerful effort to rid herself of the dead parts by the establishment of a line of demarcation. On the establishment of this, the pain often ceases.

In case the primary obstruction is in the vein and it becomes obliterated, extensively and completely, by a thrombus or by a simultaneous venous and arterial thrombosis, then the gangrene will be of the moist instead of the dry variety. It will present the usual appearance of moist gangrene. The vessels at the the seat of the obstruction will be very tender and can be felt as hard cords. The clot will extend sometimes rapidly and widely, and the gangrene will be more extensive in the area involved and far more acute in its disastrous clinical course, as would naturally be expected.

In the variety of gangrene beginning in the peripheral vessels, the symptoms will vary somewhat. It is not so uniformly in the lower extremity, and is much more frequently symmetrical. If small in extent, pain is not

apt to be a leading feature. The onset is often earlier, and from the nature of the case its progress is more acute and its limits more quickly defined, so that usually, within a few days at least, the boundary of the gangrene is well defined. Its area also is usually much less than in those cases in which a perceptible coagulum exists, not often extending in the leg beyond the foot or ankle; and if it occur in the nose, ears, genitals, etc., it rarely involves surrounding parts to a large extent. Sometimes, however, it may extend more widely, as in a case of typhus and starvation, mentioned by Lyons,* in which the patient walked to the workhouse, and on baring his chest the whole of the right side was "a dark, olive-green, jelly-like, tremulous mass." The abdominal wall is sometimes similarly involved. The probably irregular area in which the stasis of the blood will take place in this form, also accounts for the great irregularity generally seen in the line of demarcation; whereas, if a well-defined thrombus exists in a large vessel, the gangrene is apt to be fairly evenly bounded. This sudden history is usually followed by a speedily decided issue. Death follows quickly, or reaction and recovery set in within a short time, instead of long hanging in the balance.

In my Toner Lecture, I collected in all 113 cases of gangrene, to which Dr. Westcott has added 90, making 203 in all. Excluding from the former collection 34 cases of typhus reported by Estlander in Finland, of the remaining 169 cases 115 followed typhoid fever and 40 typhus fever. Some of the latter were undoubtedly really typhoid. In the following *résumé* I shall combine the results of the former and the later series together.

The influence of age is not very marked. Of 140 cases, 26 appeared before fifteen years of age, 64 from fifteen to twenty-five, and 50 after twenty-five years of age.

* On Fever, 191.

This will not differ much from the normal age-distribution of typhoid.

But sex seems to have a marked determining influence. Of 155 cases, 90 were males and 65 females, or about three to two.

The site of the gangrene is more striking than either age or sex. In six cases it attacked the ears, in 10 the nose, in 47 the face, neck and trunk; in 5 the arms, in 20 the genitals, and in 126 the legs; that is, of 214 cases in which the location is stated, in 146 it was in the lower extremities and genitals, and in 16 more in such peripheral districts of the vascular system as the ears and the nose.

I have found in the two series 128 cases of venous coagula following typhus and typhoid, especially the latter, in which the site is stated. Only four cases involved the upper extremity alone, two of which were followed by gangrene. Two involved both arm and leg, but all the other 124 cases were limited to the lower extremities. Gangrene of both venous and arterial origin (including both thrombosis and embolism) form most frequently during or just after the period of greatest cardiac weakness, a weakness felt most at such distant points as the legs. Of 41 arterial cases, 18, and of 107 venous cases, 40, occurred in the second and third weeks of the fever — that is to say, of 148 cases 58 (39.2 per cent.) occurred in the second and third weeks.

These figures, it seems to me, are most instructive. In discussing the pathology, I gave marked prominence to the sluggish peripheral circulation as a mechanical factor in the production of the gangrene. Even though we admit in many cases the determining influence of the bacilli of typhoid, the striking clinical fact above established must be explained by any accepted pathology. If arteritis or phlebitis or emboli of cardiac origin, whether bacillary or not, were the sole or even the preponderating cause, then gangrene

certainly should attack the upper extremities, the head, the neck and trunk with far greater frequency than is seen by these statistics. Just as in gangrene from other causes, often of non-bacterial origin, such as ordinary senile and diabetic gangrene; or of bacterial origin, as in scarlet fever, measles and the other exanthemata, the legs suffer so much more than all the other parts of the body put together; so in typhoid grangrene the familiar rule holds good.

It is also in the lower extremities that venous thrombi causing phlegmasia alba dolens are most frequent in other diseases of microbic origin, as in puerperal fever, pneumonia, septicemia, pyemia and even in tuberculosis and malarial fever. In both classes of diseases arising from half-a-dozen or more different bacteria or entirely apart from any bacterial influence, the one striking fact is that the legs suffer far more frequently than all other parts of the body put together. It is, it seems to me then, good common sense and good pathological sense to seek for the efficient, the exciting, the actual cause determining the location of the thrombosis and the frequent gangrene in legs themselves as legs, that is, as distal parts of the circulatory system.

The distribution as to left- and right-sided gangrene is very striking. In the early series, I did not make such a differentiation, but in the present series of 90 cases I have found that of 46 cases of arterial gangrene, eight occurred on both sides, 19 were right-sided and 19 left-sided, showing an exactly even distribution. In the veins, however, the facts are strikingly different. Both sides were affected in only four; the right side alone in 10 and the left side alone in 38. This, as we know, is in accordance with the usual experience in other diseases. Why the left side should be so much more subject to gangrene due to venous obstruction, as also to phlegmasia alba dolens,

than the right side, has been a subject of speculation for many years. My own conviction is that the obstruction to the return of the venous blood by reason of the compression of the left common iliac vein where it passes under the right common iliac artery is the most potent factor, slight in itself it is true, but when the blood is in unstable equilibrium between fluidity and coagulation, this slight retardation is in most cases just sufficient to precipitate the coagulation upon the left rather than upon the right side.

The same predominance of the left over the right side holds good in cases of venous obstruction, and the same balance of the two sides in cases of arterial obstruction, when they are not followed by gangrene. Excluding three involving the Sylvian artery, all of which occurred upon the left side, producing right hemiplegia,* and one of the right brachial artery, of the cases of arterial thrombosis without gangrene, six were right-sided, and five left-sided, while four were bilateral. Of the cases of venous thrombosis without gangrene, three were bilateral, 13 right-sided and 31 left-sided, or combining together the cases of venous obstruction, whether followed by gangrene or not, seven were bilateral, 23 right-sided and 69 left-sided, while in arterial obstruction the bilateral cases number 12, the dextral 25 and the sinistral 24. This extraordinarily even distribution would seem to suggest that the cause in cases of arterial obstruction is much more frequently embolic than has been hitherto believed.

While the male genitals and perineum are attacked by gangrene occasionally, it is in women especially that we find the widest spread havoc. I have found in all 20 cases, of which 16 followed typhoid and four followed typhus.

* For an important contribution to this rare sequel of typhoid see Osler, Recent Studies in Typhoid Fever, Johns Hopkins Hospital Reports, vol. v., and in the Journal of Nervous and Mental Disease, May, 1896, p. 295.

Fourteen cases were in young persons from seventeen to twenty-seven, except one child of five and five women of thirty-two years of age and over. In 17 of these cases, there was gangrene of the labia extending sometimes to the perineum and the thigh.

The disorder manifests itself either as a distinct gangrene of the external genitals or by gangrenous ulcers forming in the vagina. The former occasionally is followed by complete closure of the vagina and retention of the menstrual flow as in a case reported by Martin* in which sloughing of the upper vagina and the entire cervix uteri occurred. The vaginal ulcers appear usually on the posterior wall and lead occasionally to recto-vaginal fistula as in two cases reported in my former table, one case of vesico-vaginal fistula in the present table reported by Schick,† and in the fourth, my own case, both recto-vaginal and vesico-vaginal fistulæ occurred.

A *résumé* of this unique case, of which I quote the earlier part from my former lecture, is as follows:

Mrs. M. D. was under my observation in St. Mary's Hospital from 1873 to 1876, and is the only case I have found of both recto-vaginal and vesico-vaginal fistulæ. Up to March, 1872, she was perfectly healthy, when, at the age of thirty-four, she had a severe attack of typhoid fever for four months following exhaustive nursing during her husband's fatal illness also from typhoid. About the fourth week the labia minora sloughed away to a large extent and both water and feces passed by the vagina. In October, 1872, she was admitted to the hospital, under the care of my colleague, Dr. Grove, with two large vesical openings (separated by a slight bridge of tissue), which had destroyed the posterior part of the urethra and the floor of the bladder up to the uterus, and one rectal opening an inch in diameter, and one and a half inches above the anus. Dr. Grove operated on her three times unsuccessfully;

* Centralb. f. Gynekol., 1881.

† Wien. klin. Woch., 1892, vi., 413.

once on the rectal opening by the rectum, when he divided the sphincter, and twice by the vagina. From December 1873, to December, 1875, I did nine operations. Thrice unsuccessfully I attacked the fistulæ proper, when, becoming convinced that the attempt to close them was hopeless, with her entire consent after a full explanation of the consequences of the operation, I proceeded to close the vagina. At first I attempted to preserve and utilize the remnant of the urethra, which gave me great trouble and necessitated several operations; but at the twelfth operation, December 28, 1875, I gave up the attempt, excised the useless urethra and closed the entire vulval aperature by ten silver sutures. The operation was a complete success. At the time of the delivery of that lecture, nearly seven weeks after the final closure of the vulva, I stated that she defecated, menstruated and micturated entirely by the rectum, and without the slightest trouble. She rose usually once, sometimes twice, in the night, and micturated only five or six times during the day. My greatest fear was that the feces softened by the urine would pass into the vagina or bladder and give trouble, but up to that time at least none had arisen, and she was happily rid of the annoyance which had continued four years. Soon after this, however, a small fistulous opening appeared in the cicatrix, caused probably by the feces. This healed after a thirteenth operation, and when my lecture was printed (May, 1877) she had remained entirely well for over fifteen months. In the last four operations, instead of the usual sigmoid female catheter to empty the bladder, I inserted the curved branch of a pocket-case male catheter into the bladder and the vagina through the recto-vaginal fistula, thus draining these cavities, while I drained the rectum below the eye of the catheter, by an ordinary drainage-tube inserted into the rectum, lest the feces should be softened by the urine and then pass into the vagina. They answered admirably. The difficulty in obtaining a cure, I believe, lay partly in the inherent difficulty of the case, and partly in her deteriorated health ever since the fever.

Her later history is as follows:

Menstruation ceased in February, 1887, over eleven years after the closure of the vagina. December 11th,

1888, she again came to me complaining of pain in her rectum and vagina, and stated that the urine was intermittent, sometines escaping and sometimes not. She told me that for the thirteen years since the last operation she had been absolutely comfortable, that she was only obliged to rise about twice in the night to evacuate the rectum and that neither the urine nor the menstrual flow, while it had continued, had irritated the rectum, nor had the feces annoyed her by gaining access to the vagina so far as her sensations went. By inserting a finger into the rectum, I found the old fistula between the vagina and the rectum had so contracted that it would barely admit the point of my forefinger. This examination showed at once that there was a calculus formed in the vagina, which acted like a ball valve. I readily, of course, crushed it by means of a pair of curved forceps introduced through the rectum. The portions I secured uncrushed weighed 70 grains and measured $\frac{3}{4}$ by $\frac{5}{8}$ of an inch. She made an entire recovery in three or four days.

A month ago, on May 7, 1896, she called again to say that while she had been perfectly comfortable for the seven years since the removal of the stone, three weeks ago a small abscess had formed at the former outlet of the vagina and that that morning the urine had commenced to dribble away. Examination showed the orifice of the vagina firmly closed excepting one small point just admitting a probe, through which some urine was escaping. Rectal touch showed that the recto-vaginal fistula was the same as before. I advised her to keep the parts clean and wear a napkin, and wait to see whether the small fistula would not close spontaneously. In two weeks this hoped-for result followed, and she is again entirely relieved of her distressing disability.

The case is particularly interesting, not only for its unusual character and its cause, but I believe it was possibly the earliest case in which the urethra itself was entirely removed and the vagina closed, the rectum thus being made to serve the triple purpose of a reservoir for the urine, the menstrual discharge and the feces. It is an encouraging fact that in any case requiring similar treatment, the later

history shows that for over twenty years she has only twice had the least trouble, once from a small calculus forming in the vagina and once from a small abscess forming in the cicatrix, which abscess has spontaneously closed. Instead of being a constant source of disgust to herself and every body about her, a hospital patient dependent upon charity, as she could not earn her daily bread, and a pariah cut off from all society, she has been enabled to become self-supporting as a nurse, and to enter freely into her wonted social relations.

Gangrene extends to the perineum or arises primarily around the anus in a few cases. I have notes of eight men and six women, the sex not being given in two cases. Excepting three cases of eighteen, twenty-one and twenty-two years of age, they all occurred, when the age is stated, from thirty-nine to seventy-four years of age, later in life than most of the other sequels of typhoid. This is presumably due to the fact that in later life the nutrition of the perineum is apt to be less vigorous than in early life. Excepting one in the second week, they all arose rather later than other cases of gangrene; namely, from the third to the seventh week — in other words, during distinct convalescence; and to this is probably due the fact that ten recovered and five died. In a number of cases the bones of the pelvis were involved as well as the soft parts. This also probably partially accounts for the later occurrence of these cases.

Occasionally gangrene attacks very unusual regions or organs. Thus single cases are reported of gangrenous suppuration of the gland of Bartholin (Spillman);* of the tongue (Gaston David);† of the uvula (Freudenberger);‡ of both ears (Sanda);§ of the lips (Spillman).‖ The

* Arch. Gén., 1881.

† Quelques consid. sur la gangrène typhoide, Thèse de Paris, 1883.

‡ Aerzlich. Intelligenzbl., 1879, xxvi., 542.

§ Rev. Gén. de Clin. et de Thérap., 1892, vi., 401.

‖ Marc. Méd. 1895, No. 131, 145.

cheeks are attacked more frequently, and noma and cancrum oris are noted in my table as having been observed nine times, and as usual is very fatal, five of the nine having succumbed, the result in one being unrecorded. The lungs also suffered from gangrene in five cases, of which three died. As to all of these, there is nothing peculiar calling for more than their mention as indicating the protean manifestations of typhoid gangrene.

III. TREATMENT.

To the treatment which I advocated twenty years ago little can be added. The preventive treatment is the most important, such as good food, fresh air, the best hygienic surroundings. Should the heart flag, the stimulation must be maintained at all hazards; alcohol in liberal doses is perhaps the best remedy. Digitalis, strychnine, spartein, strophanthus and other cardiac tonics of the later pharmacopœia may be added. The body should be carefully examined, especially those parts of it which experience has shown are most likely to be attacked, pre-eminently the lower extremities and the genitals. The arms, neck and head being exposed are much more likely to attract attention should they be attacked by gangrene than those which are covered by the bed-clothes. If baths are used, care should be taken that no mechanical injuries are inflicted, especially on the legs. Chapman's ice and hot-water bags, alternate heat and cold, with very moderate friction and stimulating liniments should be advised and the use of the constant current as a means of stimulating the collateral circulation, both in the deep as well as the superficial parts, will be of service. If gangrene is not only threatened, but actually sets in, the gangrenous parts should be kept as aseptic as possible by the free use of antiseptic dressings.

The question of amputation naturally is one of the most important that is raised. In gangrene of the genitals,

head, neck and trunk, operation of course is limited to the removal of the dead and sloughing tissues and especially in the promotion of the utmost cleanliness, particularly in parts of the body soiled by urine, feces or the menstrual dischaage. Detergent washes and stimulating douches, the keeping of the rectum free from accumulated feces and thorough and free incision in abscesses in the vicinity of the anus are to be especially commended.

In the extremities if amputation is necessary, the time when it shall be done depends largely upon whether the gangrene arises from distinct obstruction by a palpable thrombus or embolus, or whether it arises in the peripheral vessels without such an appreciable mechanical obstruction of the main vessels. In the latter case, the line of demarcation is usually established pretty early and the disease is generally unlikely to advance beyond this line. Amputation, therefore, should be done as soon as the line of demarcation is well pronounced, and it may be done but little above this line, since there is no obstruction in the vessels higher up which would threaten the integrity of the flaps.

In the cases where a distinct thrombus or an embolus has formed, however, the obstruction is very apt to extend farther and farther as time goes on by secondary thrombosis. At what level, therefore, the limit between the tissues which must necessarily die and those in which nature can still keep up a healthy life will occur, cannot be stated definitely until the line of demarcation is well established. But the facts obtained by a study of my two series of cases aid us very distinctly in this matter. When the clot extends only up to the popliteal, the leg may escape gangrene altogether, and should it follow I have found it limited in 21 cases to the foot six times, to the lower half of the leg once, and to the upper calf in 14 cases. When the clot extended into the femoral, the gan-

grene extended to the upper calf in 11 and to the thigh in eight cases. When the clot extended above Poupart's ligament, the gangrene was limited in 15 cases, to the foot in one, the calf in eight, and extended above the knee in six. Amputation in these cases, therefore, should not be done, as a rule, until a well-defined and probably final line of demarcation has been formed. When operating, the leg should be made bloodless by elevation and kept so by very careful digital compression. The Esmarch bandage, as pointed out by Quervain, should not be used, partly because it may injure the vessels of the stump and so favor a new arterial or venous thrombus, partly because it may break up an existing venous thrombus and give rise to a dangerous embolus. To this I would add another evident objection, that the septic fluids in the tissues should not be forced into the general circulation. The hemorrhage will be slight, since certainly the artery and often both artery and vein will be obstructed, so that the "muscles will look like meat soaked in salt and water, and there will be no oozing from the marrow of the bone."*

Quervain's method of operating was both ingenious and useful. After forming an anterior flap and before making the posterior flap containing the vessels of the lower thigh, he disarticulated only the bones at the knee joint, dissected the femur loose for twelve centimetres above the joint, and divided the bone, then exposed the vessels and ligated them, and last of all formed his posterior flap. The wisdom of ligating the artery before dividing it was shown by the fact that in the amputated part it was found to be filled with a loose clot, which would almost certainly have been dislodged by the manipulation if the flap had been made prior to ligation and so have caused considerable hemorrhage. Such patients have not a drop of blood to spare.

As a general rule, therefore, we should wait for the line

* Drewitt, Lancet, 1890, ii., 1023.

of demarcation, but the operation should not be deferred long after its appearance. If danger of septic infection or speedy exhaustion should appear, immediate amputation at or above the probable limitation of the disease should be done. The extension of the disease, if the femoral be free, will not be, in the majority of cases, above the tubercle of the tibia. If the femoral be involved, necessitating an amputation of the thigh, the resources and the safety of modern antiseptic surgery would lead us in general to amputate, but in some cases it may be a serious question whether expectant treatment and a relatively long-subsequent amputation might not be less dangerous than an earlier operation.

ARTICLE III.

THE PULMONARY INVALID IN COLORADO.

By CARROLL E. EDSON, M.D.
OF ROXBURY.

READ JUNE 10, 1896.

THE PULMONARY INVALID IN COLORADO.

CERTAIN features in the life of a pulmonary invalid in Colorado have impressed themselves deeply upon me during a year and a half's residence in that State. They are non-statistical, every-day facts. They can be appreciated fully only by actual experience or observation; but they are of such direct and vital importance to the well-being of the invalid that I wish to bring them to your careful attention.

The meteorological statistics of Colorado climate which you are acquainted with, are chiefly those of Denver and Colorado Springs; but please remember that Colorado is nearly four hundred miles long by two hundred and eighty miles wide, and varies in altitude from three thousand to fourteen thousand feet above sea level. Short distances, particularly in the invalid belt, along the eastern slope of the mountains from Pueblo to Fort Collins, make marked difference in the weather conditions. This is especially so about Colorado Springs, where the isolated mass of Pike's Peak acts as a storm centre and meteorologic eccentric of considerable moment. Arrapahoe county, of which Denver is the seat, is alone as large as Massachusetts and of about the same shape. Parts of the state especially attractive to newcomers, because of game or gold mines, are entirely unsuitable for an invalid. Do not then think, from your knowledge of general sun and humidity statistics, that it suffices to send a patient simply to Colorado, to settle where he may please.

The two factors most essential to a successful use of Colorado climate for pulmonary tuberculosis are these: Early diagnosis with prompt exile, and especially medical control of the case from the start in the new climate. The importance of the first, and the great advantage of climatic therapeutics in the early stages of pulmonary phthisis, the malarial stage, if I may so call it, of debility, slight febrile movement, a quick pulse, and few or dubious signs on chest examination, cannot be insisted upon too strongly. It is not my purpose, however, to discuss here the question of climate or altitude. I assume throughout this paper that the invalid has been sent to Colorado as the place best suited for his case; and by *invalid* I mean a person sent to Colorado because of tubercular disease, no matter how slight or localized the invasion, or how little impaired his general health.

Let me only say that Colorado as a last resort, when the patient has gone steadily from bad to worse in Florida or Saranac or Asheville, is very different from Colorado at the start. As Fisk says, "There should be no more delay in the wise selection of climate than in the early diagnosis of the disease. Delay is dangerous. Tentative methods are not to be tolerated. The patient is entitled to the best that medical experience can offer."

What I wish to call particularly to your attention is the need of proper control of the patient while in Colorado. Hope alone, even "*spes phthisica*," or air even that of Colorado, if misused, will not cure tuberculosis. Many patients, arrived in Colorado, act, sometimes it must be said under advice from physicians at home, as if the end were gained and they had no more responsibility. In reality the fight has but begun and it is a fight to the finish with the deadliest foe man has. It lasts a man as long as he lives, and is won not by some great sacrifice, even the going West, but is gained only by constant unceasing watchfulness of little

things. "Every impairment of digestive power, every decline in muscular vigor, every breath of foul air breathed is a point lost in the fight in which every item, however apparently trivial, tells in the long run."

A change of climate, with no attention paid to change from confined, unhygienic occupation and injurious habits, to a proper out-door existence, is a game but half and poorly played. Proper housing and abundant nourishing food are as essential in Colorado as in New England, and require local knowledge and careful search to find.

The city of Denver itself is often smoky, and a city anywhere is not the place for a pulmonary invalid to live in. The suburbs of Denver, however, to the east, southeast or west, are so situated in reference to land configuration and wind currents as to be entirely free from smoke, and offer as clear an atmosphere as that of Colorado Springs. The elevation is a thousand feet less than the Springs and much more agreeable to many persons. I found, myself, that although I was not troubled by the altitude at the Springs, a return to Denver gave me an immediate sense of greater energy and well-being.

Such suburbs of Denver as Montclair, University Park, Petersburg or Berkeley, are admirably suited for invalids and are all within the street car service. Living in Denver is less expensive than at Colorado Springs.

Many places in Colorado, and especially some of the newly recommended towns in Arizona and New Mexico, while excellently adapted atmospherically, are absolutely unfit for an invalid by the impossibility of procuring proper food. Ordinary ranch-life, with its changeless diet of soda biscuit and bacon, is undesirable for a patient who needs easily obtained nutrition. A strong man can go with advantage into the wilds of the White River country after large game, but the hardship and rough diet of the trip will undo an invalid's winter gain. I have seen more

than one patient seriously and permanently set back by such a summer's outing.

Let me impress most deeply upon you that an out-door life in Colorado does not necessitate roughing it, and for the patient with phthisis should not include it, no matter how slight the invasion or apparently vigorous his condition. You do not realize, perhaps, how often patients, particularly incipient cases, are sent west with the remark by their physician, "Oh! live out of doors; have a gun; live in the saddle. So long as you gain in weight and are feeling stronger, you need not see a doctor." So they do not, till a longer ride than usual, or an exposure to a Colorado wind, with its penetrating power of tiring you out, puts a stop to their improvement and starts them "down hill." The golden opportunity for the invalid in Colorado is the start and the keeping it.

The first response of the patient to the new climate is often astonishingly quick. There is a quality in the dry, warm, gloriously sunny air which seems with each breath to efface that sense of hopeless tire so common in incipient cases. It is not uncommon to see patients gain two pounds the first week in Denver, and, *under proper regimen*, to continue at that rate for a month or more. In my own case, if you will pardon a personal allusion, there was a gain of fourteen pounds in the first six weeks, and an almost entire cessation of cough in the first three. With the gain in weight comes a similar and often greater gain in nervous energy. The sun and wind soon cover the pale cheek with the Colorado bronze. The patient looks and feels like a new person.

It is needless to say that the repair of invaded tissue does not keep pace with this general gain. The plump, bronzed face is not an index of the condition of the chest. It is difficult to make the invalid newcomer realize this and feel the importance of not jeopardizing the splendid start.

It is the reward of inactivity and is forfeited by overdoing. Once lost, experience shows that the climate is chary of a second gift where her first proffer of health is neglected or misused.

Out-door life, *without exercise*, is the secret of success during an invalid's early months in Colorado. The conditions of air and sun in Colorado are such as to make an out-door existence of continued inactivity possible, in a way hard to conceive here in New England.

A knowledge of local surroundings and care in the selection of a dwelling place can make such a life possible and pleasant. A veranda open to the south and sheltered from the wind by wall or canvas screen is as important an item to secure, when house-hunting, as a well ventilated, warmed sleeping room. It is even more so, for the patient is to spend the larger part of his time out-doors. An ideal arrangement is a recessed loggia above the ground open to the south, and so sheltered always from the wind, but giving a wide view over the plains to Pike's Peak and that unsurpassed stretch of two hundred miles of mountain range. In such a nook an invalid can sit even in the shortest cold days of winter, at least seven hours every day in clear, dry air, where every breath is one of benefit.

Exercise at first should be absolutely forbidden. The elevation alone causes sufficient pulmonary work. There is chest expansion gained while the patient is wholly still. After a few weeks of quiet gain, exercise may be begun by shork walks, beginning with an eighth or quarter of a mile, a distance which seems especially ridiculous in the clear air of Colorado, where objects twenty miles away do not look five. Keeping a close watch for slight rise in temperature, or digestive fatigue, the distance walked may be gradually increased. An excellent change and one agreeable to the patient, as it allows him to get farther from home and perchance out of sight of his starting point, is driving,—not

in a high jolting trap, as is too often seen, but in a buggy with an easy gaited horse, so that the patient has no drag upon his chest and arms from tight reining. From a short drive at first, the invalid can gradually come to spending the whole day in jogging about over the plains. Horseback riding is to be long deferred and most cautiously begun. It has proved a direful cause of hæmorrhage or of set-back. It is difficult to make the invalid wait patiently for this, the most prejudged and attractive feature of his western life. The objection to horseback exercise applies with double force to bicycling.

This continued quietness is not the manner of life pictured to most patients on going to Colorado to regain their health, but it is the only one which will be without serious risk.

Let me now call your attention to a few details which directly affect the daily life of the invalid in Colorado.

The climate is very uniform by monthly averages, but the weather day to day is not always at the mean. Changes from hot to cold are as abrupt and marked as with us. There is not, of course, the damp rawness of our eastern coast, but the contrast between sun and shade is more decided. I have, myself, seen in February two thermometers on my veranda, one in the sun registering 90° F., and the other not six feet off, in the shade, at 45°. The clear, dry air holds little heat and the warmth is all in the sunshine. A thin cirrus cloud, no more than is grateful to the eyes, will take all the warmth from the air and remind you that after all it is mid-winter.

The open cars run all winter, and there are but few days when the invalid cannot ride in them. He should always have a travelling rug to throw across the knees. I have ridden seven miles in an open car at eight o'clock in the evening in February without discomfort; but there is no time when a patient should go far from home without a

wrap, even in warm mid-day. The wind comes suddenly and strong from cloudless skies, and many days, though warm and sunny, are far too windy for an invalid to walk or ride. While the wind may last but a short time it rises suddenly, and the exposure in reaching home may be great. The dust storms are less frequent, but more trying.

The battle against tuberculosis is one of detailed watchfulness. The lack of care which the average invalid in Colorado shows for the important little things is most surprising.

To have a few friends in for tea of an afternoon will seem to you a harmless diversion. Here is the picture as you see it in Colorado Springs. At four o'clock, when the western sun is streaming warm and bright across the mesa, the patient leaves the open air of the veranda and spends the next two hours in her room with six or a dozen friends. The air becomes warm and close, and the energy gained by the day out-doors is soon spent. The dry and the moist cough, not heard when the guests first arrive, begin later in the hour, and soon become an integral part of the hum of conversation. Nature sends her flush of protest to the cheeks. Two hours of glorious possibility have been lost. They have been spent in-doors instead of out, and in-doors under bad conditions.

Young men sent to Colorado should be made before they start to feel the seriousness of the fight ahead of them, and the necessity for simple living. The West is open-hearted, cordial, and essentially a man's country. Club life is offered freely and may have proper use, but for an invalid to take his afternoon's rest from a morning's over fatigue at golf or coyote coursing, upon the couch in the smoking room of never so charming a club, is not conducive to his best recovery. Piquet and poker are excitants, but fresh air and early hours are better tonics for tuberculosis. The road to health does not lead in the way of dancing, dinner and

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theatre parties. There can be no neutrality in the fight, and nothing that does not count,—whatever is not directly for recovery is against it.

I put this earnestly, but the recovery of health from tuberculosis is not a pastime. As Fisk says, "It is a hard business, requiring unremitting attention, constant daily care and a stout heart." The timely courage and restraining word which can come with effect from the physician only when he is in close touch with his patient, are of untold worth. From the few details, even, which I have called to your attention it will be obvious to you that we here cannot direct our patients out in Colorado. Do not then prejudice a quick and sympathetic accord between your patient and his new doctor by careless and erroneous speech about his new western life. Not for him are "the wild joys of living * * * * the hunt of the bear." His proper conduct is a quiet, well-nourished, out-door life. Our duty in the East, if we are to do it to the full towards the patients we send to Colorado, is:

To make earlier diagnosis.

To send our patient away at once while his chance for full recovery is best.

To send him not simply to Colorado, but to a *physician* in Colorado, unprejudiced as to manner of life, admonished to confide and obey.

ARTICLE IV.

THE TREATMENT OF PHTHISIS IN SANITARIA NEAR OUR HOMES.

By VINCENT Y. BOWDITCH, M.D.
OF BOSTON.

READ JUNE 10, 1896.

THE TREATMENT OF PHTHISIS IN SANITARIA NEAR OUR HOMES.

WHEN requested to address you upon the "Home Treatment of Phthisis," I asked permission to change the subject, feeling that I could, perhaps, give you something of greater interest if I attempted to show you the results obtained by the sanitarium treatment of phthisis near our own city, as illustrated by five years' experience at the Sharon Sanitarium for Pulmonary Diseases in Sharon, Mass. In presenting the results of the work there, it is with the hope that the idea of establishing sanitaria for treating tuberculosis may grow steadily in favor, so that instead of small isolated institutions here and there in the United States, we may have in the immediate vicinity of our large cities in every State suitable establishments where people of limited means, who are showing the first signs of consumption, can be sent with the hope of arresting the disease in its early stages, even in insalubrious climates. In Europe, much more rapid advance has been made than in America in the past few years in these matters. Of late, the French government, convinced of the usefulness of such establishments, has taken steps to found sanitaria for consumptives in various parts of the country. Brehmer, the father of the idea of sanitarium treatment for consumption, has left behind him his now great and celebrated sanitarium at Görbersdorf as a proof of the correctness of his views advanced nearly forty years ago. His

pupil, Dettweiler, later established the sanitarium at Falkenstein, near Frankfort, and his name is now as well known throughout the medical world as that of his great predecessor.

Numerous similar institutions in later years have been founded in various parts of Germany, and their results are showing already how much can be done even in the harsh cold winters of North Germany.

In England, Scotland and Ireland also, they are following the example of the Germans. Even in the damp, chilly climate of eastern Scotland favorable results are being reported at the Craigleith Sanitarium for the consumptive poor near Edinburgh.

The Adirondac Cottage Sanitarium at Saranac Lake, N. Y., and the Winyah at Asheville, N. C., are now well known in America, the former only, however, being intended for people of very moderate means. Others exist in Colorado, Southern California and in the South, but, so far as I know, the Sharon Sanitarium is the only one in New England which is intended exclusively for people of very limited means.

The people of New York city, however, have within the past year founded an institution at Liberty, N. Y., intended for cases of incipient phthisis in connection with consumptive hospitals in the city.

The Rush Hospital for Consumptives in Philadelphia, Pa., and another similar institution near Baltimore, Md., should be mentioned, but I do not understand them to be devoted especially to cases of consumption in its early stages.

As I review the records of the Sanitarium and recall the cases of those in whom arrest of the morbid process has been accomplished, it is gratifying to find that my former belief in the efficacy of such treatment for a good percentage of cases even in our own harsh climate was not unfounded.

In presenting to you these records of five years' experience, I should not be so foolish, of course, as to claim results equal to those coming from a radical change of climate such as is possible for the wealthier classes, but I merely wish to show, if I can, that what has been accomplished at Sharon is vastly more satisfactory than any attempt, in my experience at least, to treat patients in their homes or at the office in this part of the country.

The reason for this would seem to be obvious. A bright, cheerful home is provided at very slight cost to the patients, where in addition to good food and the excellent air of a healthy country town, medical supervision is kept up at a period of the disease when it is of vital importance that the patient should not be allowed to follow his own inclinations as to exercise, food or general mode of life.*

Contrast this with the usual method of treating the poor or even the wealthier class of patients at one's office. It is impossible under such conditions to control as one should the actions of even the most intelligent, and, in such a climate as ours, the results are discouraging to the last degree.

Even at the Sanitarium we inevitably meet with certain cases, of course, which in spite of every effort steadily and surely lose ground; but there are others which after a stay of many months, possibly, at Sharon, have remained in apparent perfect health, and it is these cases which have proved to me how much can be done with comparatively simple means, and how much more can be accomplished with increased facilities for the treatment of consumption when patients are kept under the close supervision of a sanitarium not far from home. You will notice that I have in no case used the word "cure," but have confined myself to the term "arrest of disease," simply because I do not

* The price of board at the Sanitarium is $5.00 a week, which includes medical attendance, medicines, and everything else but washing. Only women are received at present.

feel that the former term is justifiable until after a number of years in which the patient shows no signs of relapse. If the general appearance, however, of the patient can be taken as an indication of his condition, the term "cure" might certainly have been used in many of the cases which I have reported as "arrested." In some, moreover, who have been away from Sharon for two or three years and report themselves as in perfect health, we should be justified in saying that they stand as good a chance of living long lives as anyone, but I have thought it best to adhere to the less absolute term.

In a paper entitled "Three Years Experience with the Sanitarium Treatment of Phthisis near Boston," I gave to the American Climatological Association at Washington in 1894 the results of forty cases of consumption treated at Sharon. Ten of these were reported as "arrested," and later in this paper I shall hope to give their succeeding histories. The full accounts can be found in the Transactions of the Climatological Association for 1894, or in the Boston Medical and Surgical Journal of July 12 and 19, 1894.

In the past two years, up to March 1, 1896, twenty-six cases have been admitted to the Sanitarium. Two of these remained less than five weeks and are, therefore, not included. Of twenty-four cases treated in the past two years, seven who have left the Sanitarium were called "arrested cases," the details of which will be published with this paper. Of the remaining seventeen, one (No. 64) was a suspicious case without very definite signs except anæmia, a slight cough without expectoration, and a questionable dry crepitation near the spine of the left scapula. She left at the end of four months perfectly well, and has remained so since, "never better in her life" at last accounts. This case, however, was not classed with the "arrested" ones, because of the doubtful nature of the trouble.

Twelve others (Nos. 55, 57, 60, 61, 62, 66, 67, 69, 71, 73, 74, 75) were all cases of more or less advanced phthisis in one or both lungs, several of whom were admitted merely as an endeavor to better their condition, with little or no hope of cure. Eight of these showed a greater or less degree of improvement in their general condition; four of them were not benefited. Four others were really incipient cases (Nos. 58, 68, 72, 76), two of whom having opportunities to live in Colorado left Sharon after a stay of three and one-half and six months respectively, with decided improvement in general symptoms, but with no change or a slight increase of local symptoms; one other left after two months, decidedly improved, and one is still at the Sanitarium, the picture of health, with little or no cough, the bacilli having disappeared from the sputa since the early winter.

In addition to the ten "arrested cases" recorded in my paper before the Climatological Association, five who were then under treatment and classed as "much improved" have since been discharged as "arrested cases," the last one having left Sharon a year ago. Of these, four are very well (Nos. 31, 33, 36 and 48), no symptom of return of the disease having yet appeared; one (No. 42), after a stay of nearly two years at the Sanitarium (with the exception of short intervals, during which she had to undergo serious operations at the hospital for uterine disease of unknown nature), left Sharon with the signs of the original lesion in the left lung quite healed, and finally died at the City Hospital following a severe operation for a uterine tumor. Just previous to her death I was able to carefully examine her lungs, and the only trace of her original trouble was a faint dry click occasionally heard in the left supra-clavicular space upon respiration. This result was corroborated by a member of the staff. Most unfortunately, no autopsy was allowed upon this most interesting case, and the nature of

the abdominal tumor was never known. The details of these cases will also be published with this paper.

It is, of course, impossible in any paper to convey the impression made upon the observer by individual cases, and any attempt to recite in detail the results of each case would only weary, without convincing the listener probably. In giving percentages, moreover, there must inevitably arise small sources of error, but in publishing results I have tried to avoid the "personal equation" in the description of cases, and can only emphasize what I have earlier stated, that the number of patients whom I have seen improve or in whom the symptoms of disease have disappeared at the Sanitarium is much greater than I have ever seen by ordinary methods of so-called "home-treatment" in Boston.

I am aware that possibly the diagnosis in some of the published cases may be challenged, because of the failure to discover bacilli in the sputa, when the physical signs were very slight. I can only say in reply to this, what we all surely know, that the absence of bacilli is no proof of the absence of tubercular disease; that in many cases which show undoubted evidences of phthisis, upon physical examination we may fail for months to find bacilli in the sputa, and for myself there are certain evidences of incipient trouble, *e.g.* a change in the character of the percussion note or the respiratory murmur in the apex of a lung in conjunction with general signs of departure from health, like fever, malaise, loss of flesh, etc., that mean infinitely more to me than the mere evidence of the microscope alone, whether positive or negative.

With these remarks as a preface, then, let me state that out of sixty-four cases of phthisis treated in the Sanitarium in the last five years, twenty-two have been classed as "arrested cases," a little more than 33⅓%. Of these, four (Nos. 3, 37, 41 and 42) have since died, and in two others (Nos. 1 and 63) the symptoms of disease again appeared

not many months after leaving Sharon, but they are still living. Of those who died, however, one showed no evidence of return of pulmonary trouble, but died after a uterine operation; two others resumed, against advice, the same mode of life as before, and pulmonary disease again developed. Another died from some rectal disease, the nature of which could not be known as the patient was lost sight of. Good accounts are obtained of all of the others, as far as pulmonary symptoms are concerned, the majority having left the Sanitarium more than two years ago.

Granting that phthisis in a number of cases is a self-limited disease, and that such cases get well under any conditions (Austin Flint having claimed that about 11% are probably self-limited), and granting that evidences of tubercular processes are found in the lungs of numbers of people who have died of non-tubercular disease, yet I feel I am justified in maintaining that the results in this comparatively limited number of cases rest on something much more than mere self-limitation of disease, and that they are such as to warrant the establishment of similar institutions near every large city or town.

The work at the Sanitarium has been greatly aided by the almost daily presence of a medical assistant, and of a most efficient matron, a former trained nurse, to whose unremitting care those of the patients who have regained their health largely owe their lives. That still better results can be accomplished by the presence of a resident physician I have no doubt, and it is my earnest desire that at no far distant date, with increased funds, this, with other necessary improvements, will be accomplished.

METHODS OF TREATMENT AT THE SANITARIUM.

After many trials of various remedies, I am still convinced that fresh air, sunlight, good food, with judicious exercise, whether in the form of pulmonary gymnastics or otherwise,

are the chief factors in whatever good results have thus far been obtained. The so-called "peppermint cure" has been faithfully tried with negative results as far as any curative action is concerned, although it seemed in certain cases to ameliorate some of the symptoms, especially the cough. It should be said that it was impossible to use the mixture recommended by Curasso, to be taken by the mouth, as the amount of alcohol caused marked symptoms of intoxication, and a modified form was given, the chief ingredients being creosote and oil of peppermint, but the other details of his treatment were closely followed.

Klebs's "Antiphthisine" has been used also in several cases, and I regret to say that the results in my hands have not convinced me of its curative power. It has been given carefully in accordance with the recommendations as far as possible, and in one or two cases improvement was noticed, but not more than I have noticed by different methods. Creosote alone has been tried, but without positive proof of its special value in my experience, except as a corrective to the digestion at times. I have never succeeded in giving the large doses recommended by some on account of the intolerance of the stomach for such amounts.

Tuberculin has never been used at Sharon, my experience at the Carney Hospital in South Boston, previous to the opening of the Sanitarium, having convinced me that it was wiser to wait until we have heard more upon the subject from Koch before making further experiments. The methods pursued have been chiefly these: — regular hours of sleep; rest in the open air, even in the coldest winter weather, on the piazza in the sunshine; exercise by walking, regulated according to the condition of the patient; pulmonary gymnastics in the form of ordinary calisthenics, to develop the chest muscles, or by means of the pneumatic cabinet, regular treatment with which has a markedly beneficial effect upon the expansion of the chest. When

used judiciously I have never seen harmful results from this treatment, and the patients almost universally speak of the sense of freedom in breathing after its use. At times the combination of a medicated vapor with the cabinet has a soothing effect, especially if a general bronchitis is present, but I have no faith in the germicidal effect of any vapor used in this way as sometimes recommended. Pulmonary gymnastics, then, in some form, hold in my opinion a very important place in all methods of cure of consumption, and chief among them stands the pneumatic cabinet or some equally efficacious substitute.

Tonics, in the form of the preparations of the hypophosphites, bitters, malt and iron, are frequently used, and special attention is paid to the condition of the stomach and bowels. Three regular meals in the day, with lunches, usually of egg and milk in the middle of the morning and afternoon, are prescribed, and are varied according to the patients' needs. If patients are found to be feverish, quiet is recommended rather than exercise, but, if in their rooms, the windows are always open in degrees varying with the temperature, that the advantages of fresh air treatment may not be lost.

The strictest attention is paid to the care of the sputa, expectoration being allowed only into certain receptacles which are provided for this purpose and are destroyed by fire later. When on the grounds of the Sanitarium the patients are provided with small rubber pouches containing sheets of Japanese paper, which are destroyed after use. Table napkins are of the same material, and the china utensils, spoons and forks are boiled after use at every meal. Dusting and sweeping in the Sanitarium are never allowed, but the floors and walls are wiped frequently with damp cloths, which are afterwards burned or boiled, by all of which means chances of infection are reduced to a minimum.

Special endeavors are made to procure employment which will enable the patients after they leave Sharon to be more in the open air than in their previous occupations, and it has been gratifying to find how many continue to practise the hygienic methods and gymnastic exercises which have been taught them in the Sanitarium.

It may be well for me to refer to what I have alluded to in previous papers, viz:—the idea that the presence of others who are ill in the same institution has a deleterious mental effect upon the patients. As a matter of fact, this objection, which doubtless exists in the minds of many, amounts, not only in my experience but in that of every physician who has had control of a properly regulated sanitarium, to practically nothing when compared with the advantage to be gained. It has surprised me frequently to see how soon patients become wonted to their changed method of life after the first inevitable sense of strangeness and homesickness wears off, and how quickly they become cheerful and often happy in their surroundings. Depression comes usually from some outside source or from a cause other than the mere presence of other invalids.

As to the danger of infection in institutions where proper precautions are used, I believe it to be very slight, and the lately published paper of Dr. Irwin W. Hance, entitled "Study of the Infectiousness of Dust in the Adirondac Cottage Sanitarium," shows in a most interesting way how little we have to fear on that ground in such establishments where absolute cleanliness of the patient and his surroundings is insisted upon.

In conclusion let me say, that I should regret it very much if in my scepticism as to the curative power of any of the so-called specific treatments for phthisis thus far invented I were to give a false impression as to my own hope and belief. I cannot help feeling that we are on the eve of a new epoch in the history of tuberculosis. Steadily and

surely, although slowly, I believe we are approaching the time when phthisis may be regarded as we now regard the plague and small-pox, diseases which once were the terror of the human race, but which are now either unknown in civilized communities, or so far under control that they are no longer so much dreaded.

Preventive medicine, with its teachings of proper hygienic surroundings for those who show a tendency to weakened constitutions, either acquired or inherited, has played a most important part in the already noticeable decrease in the mortality from consumption, and to bacteriology we owe the great advance which has been made in our ability of late years to recognize the signs of incipient disease and to grapple successfully with them.

Let us, therefore, hopefully, cautiously and patiently work in the lines that experience teaches us will give the best results. If I shall have been able to convince you that the sanitarium treatment of consumption, even in harsh climates, takes a very high rank among the methods of combating this disease, and if in so doing I can induce you to promulgate the idea, not only among the medical profession but in the community generally, the object of this paper will have been accomplished.

DISCUSSION.

Dr. F. I. Knight, of Boston:—The subject which I was asked to discuss was a little different from this; it was the home treatment of tuberculosis. I am not sorry that the subject was changed, because I think it very important that the sanitarium treatment of tuberculosis should be enforced upon the profession. I fully endorse all that Dr. Bowditch has said. As long as the treatment of tuberculosis is a treatment of the condition of the patient and not a treatment of the disease specifically, the closer supervision and regulation of the patient the physician has, the

better it is going to be for the patient. After years and centuries of experience with searching for specifics, in our time we have fallen back pretty much upon the rational treatment, as we have called it, of the condition of the patient. Very few specifics are known, and although, as Dr. Bowditch has said, we have hopes, very few have been discovered, and I agree with him that as yet we have not found a specific for tuberculosis upon which we can rely, disregarding the general treatment of the patient, which is, in the present state of our knowledge, in my opinion far more important. It is possible that even now specifics so-called may exist which help out in the cure, but the main thing yet is the treatment of the general condition of the patient. Now, that holds good in Colorado just as much as it does here. The Colorado climate may be looked at in the light of a specific in a certain sense, but the patient there with good general treatment is much better off than the patient without it. It is one of the temptations to young people in Colorado to disregard medical supervision and fall into social pleasures, which I am sorry to say even some of the physicians offer to their patients. I once sent a bright young man there, whose father came to me on one of his vacations and said: "I don't want my son to go back to Dr. So-and-so's family, because he gives a dinner party every night and they sit up very late talking and smoking."

The effect upon the patient of knowing his condition and of being with others in that condition is not depressing, as Dr. Bowditch says. It is curious perhaps that it is not, but patients in sanitaria and health resorts where there are other patients of the same kind are very apt to be cheerful in talking over their symptoms. Every one seems to think he is a little better than his neighbor, and they realize the seriousness of the condition and the prolonged fight necessary to overcome it. That is impressed in a sanitarium better than anywhere else, that it is a long, hard fight, and the patients realize it and are willing to submit to regulations. The difference between the health-resort treatment and the sanitarium treatment is beautifully illustrated to my mind by the two mottoes, one of which was to be seen a few years ago, and perhaps now, in the recreation hall in the largest hotel in Davos, one of the fashionable sanitary resorts, where people generally live in the hotels and do as they

please to a great extent. The motto there is "Hilares mox sani" (Be merry, and you will soon be well). In the hall at Görbersdorf the motto is "Die Patienten kommen nicht um sich zu amüsiren, sondern um geheilt zu werden" (Patients do not come here to be amused, but to be cured). See a patient from each of those places and you will appreciate the difference. Patients from sanitaria appreciate the seriousness of the thing, realize that a day's pleasure may destroy the improvement of a year. Yesterday a young girl came into my office, twenty years old, in whom the disease had been arrested so that she had no noticeable cough for nine or ten months and felt perfectly well. Without consulting me she went back to employment in a factory, and in two months there was a fresh invasion of tubercular disease, and I fear now that she is beyond recovery. If that young woman had ever been in a sanitarium and got the morale of it, she never would have thought of going to work without finding out whether she ought to have done so. In conclusion, as far as the results go in New England, I feel sure that anybody who can be treated in a sanitarium is going to be better off than if treated at home. Of course if they can be treated in Colorado in a sanitarium, or under strict medical supervision, it is better than being treated it a sanitarium here, but I have no doubt that many of the patients who go West and roam about without medical supervision and guidance would be better off in a sanitarium at home.

RECORDS OF SEVEN CASES OF "ARRESTED DISEASES" SINCE THE PREVIOUS REPORT IN 1894.

Case I.—(No. 51). American. Married. Age 31. Entered January 31, 1894. Mother died of phthisis. Pneumonia four years before, and "congestion of lungs" eighteen months previous to entrance. Slight cough and occasional hæmoptysis since. Loss of flesh, malaise, slight fever.

Physical Examination.—Dulness in upper portion of right lung, with crumpling râles varying in intensity over most of the lung. A little later, a few râles in top of left lung. *Bacilli in sputa.* Cough persisted, although lessening, for six months, after which it practically ceased. Tem-

perature became normal. Gain of twenty-five pounds in weight. Left the Sanitarium one year and a half after entrance.

Synopsis.—Catarrhal phthisis of both lungs. Arrest of disease after a stay of one and a half years at the Sanitarium. Patient at this time, eleven months after departure, to all appearances well; the last examination showing dry râles in the apices and in lower part of right chest, but the percussion in both of good character. No cough.

Case II.—(No. 53). Entered May 14, 1894. American. Married. Age 33. Very phthisical family history. Has for several years had a pain in lower right chest, and a cough. For eight months previous to entrance cough was severe, with a good deal of sputa, occasionally bloody. Loss of flesh and strength.

Physical Examination.—Thin and pale. Right clavicle prominent. Tenderness upon percussion. Respiration jerky there. Percussion slightly dull, also in middle third of right back. No special râles detected. Pulse 108. Temperature 100. *Bacilli could not be found.* Condition slowly improved. Cough and expectoration ceased. Gain of twenty-two pounds in weight. Left the Sanitarium thirteen months after entrance, feeling well and stronger than for many years before.

Synopsis.—Incipient phthisis of right lung. Arrest of disease after thirteen months stay at the Sanitarium.

Case III.—(No. 56). Entered June 27, 1894. Nova Scotian. Single. Age 24. Domestic. Two maternal aunts died of phthisis. Never very strong. Following an attack of tonsillitis a year before entrance, a slight cough with profuse expectoration, occasionally bloody, developed. Occasional night sweats. Pain in left side for two months. Catarrh troublesome.

Physical Examination.—Slight dulness in right apex, a "squeak" heard there once, with broncho-vesicular respiration and a questionable "crumple." Nothing over seat of pain. Temperature 99.3. Pulse 100. Barring a slight hemorrhage soon after entrance, there was steady improvement in all symptoms. Cough and expectoration ceased and catarrhal symptoms greatly improved. *No bacilli found.* Patient left the Sanitarium against advice after a

two months' stay, feeling very well; the percussion in the right apex being normal and no evidence of râle there.

Synopsis.—Incipient phthisis at right apex. Disappearance of signs after two months' stay at Sharon.

Case IV.—(No. 59). Entered July 30, 1894. Sent by Dr. J. J. Minot. American. Single. Age 19. Mother and one sister died of phthisis; later, a brother developed phthisis. Two years previously had taken care of a sick sister, and later, in winter preceding entrance, took cold and began to cough, which became less in the spring. Loss of flesh. Occasional pain in the right subscapular region.

Physical Examination.—Dull in upper right back with faint "squeak," and after cough an explosion of râles. Slight tubular respiration. Respiration decidedly bronchovesicular in both apices. Voice increased in both apices. Pulse 100. Temperature 99.3. *Bacilli in sputa.* There was marked improvement from the outset. At the end of six months there was a cessation of cough and the bacilli had disappeared from the sputa when any could be obtained. The temperature became normal, and for the past year the patient has been the picture of health, and remained at the Sanitarium merely as a matter of precaution previous to living in the West. Gain of nineteen pounds in weight. At the last examination the percussion in the apices had greatly improved, and although the respiration was bronchovesicular in both tops, and after cough a few râles could be heard, yet the whole sound was of a dry character. The general signs had been those of an arrested process for a year previous to departure.

Synopsis.—Incipient phthisis in both apices. Arrest of disease at the end of six months, the patient remaining in the Sanitarium twenty-one months.

Case V.—(No. 63). Entered November 7, 1894. American. Married. Age 23. One aunt died of phthisis. Two and a half months previous to entrance developed a cough, with profuse expectoration. Some loss of flesh, chilliness, malaise.

Physical Examination.—Lack of tone in apices and faulty expansion of the chest. Slightly higher-pitched note in left apex behind. Suspicion of a dry râle about spine of

left scapula. Slight elevation of temperature. *Sputa negative.* The cough and expectoration rapidly diminished and finally ceased. The expansion of chest and percussion greatly improved by the use of pulmonary gymnastics. Patient left against advice, feeling very well, at the end of three months, as a doubtful case of incipient phthisis. Gain of nine pounds.

Synopsis.—Probable incipient phthisis at the top of left lung. Arrest of morbid signs at the end of three months' stay.

Subsequent History.—Patient returned to hard work in unhygienic surroundings. Had whooping cough later, and in June, 1895, was re-admitted, with evident signs of phthisis at the top of the left lung. *Bacilli in the sputa.* Owing to disobedience of rules and refusal of treatment the patient was discharged at the end of three months, with only slight improvement of general symptoms.

This case is shown as illustrating how the absence of bacilli in the early history was no proof of the non-existence of tubercular disease, and yet the physical signs pointed towards the existence of phthisis, which was proved several months later when the patient reëntered the Sanitarium.

Case VI.—(No. 65). Entered January 8th, 1895. American. Single. Age 24. Lives at home. Sent by Dr. George G. Sears. Family history negative, with exception of asthma in father's family. Seven years before had been anæmic. A year and a half previous to entrance had la grippe, and continued to lose flesh, and had a slight cough without much sputa. Malaise and anorexia, dyspnœa and palpitation. Just before entrance Dr. Sears had found some moist râles at the left apex.

Physical Examination.—Anæmic. Rather high-pitched percussion note in apices and sub-clavicular spaces, more noticeable in apices in the back. Respiration decidedly broncho-vesicular in both apices, most marked behind, with increased voice sounds. Later, diminution of respiratory murmur in lower left chest. Temperature 100. Pulse 88. *Examination of sputa negative.* The patient remained four months, gained twenty-one pounds, looked the picture of health; cough and expectoration ceased entirely, and temperature became normal. Although the respiration re-

mained broncho-vesicular in the apices, yet all other signs pointed to a complete cessation of any morbid process. She was advised to stay longer, but was obliged to leave.

Synopsis.—Case of incipient phthisis in one apex at least. Complete cessation of all morbid symptoms after four months. Gain of twenty-one pounds in weight. Subsequent history excellent.

Case VII.—(No. 70). Entered June 22, 1895. American. Single. Age 16. Mother and sister died of phthisis. Dry hacking cough nine months previous to entrance. Slight amount of blood. Other symptoms not marked.

Physical Examination.—Slight dullness in right supra-clavicular space, and lacking in tone in both apices. Explosion of moist râles in both tops to second ribs. Less marked in back. Respiration faintly bronchial. Voice slightly increased. Temperature 100.8. Pulse 112. *Examination for bacilli negative.* Steady improvement from the outset. Cessation of cough and sputa. Gain of fifteen and one fourth pounds in weight. The physical signs became dry in character, although they persisted at the apices after entire cessation of cough and expectoration. Patient left against advice in three months.

Synopsis.—Incipient phthisis at both apices. Patient was discharged as "greatly improved" at the end of three months, although the cessation of cough and expectoration, the normal temperature and the general appearance of health justified the term "arrest of disease."

RECORDS OF FIVE CASES PREVIOUSLY RECORDED IN AN EARLIER PAPER AS "MUCH IMPROVED," SINCE DISCHARGED AS "ARRESTED CASES."

Case I.—(No. 31). Entered May 31, 1892. Sent by Dr. C. Ellery Stedman. American. Age 17. Family history bad: father, one sister, one adopted sister, and later a brother, died of phthisis. Perfectly well until one month previous to entrance, then took cold and a cough with little or no sputa persisted. Loss of flesh and strength, pain in chest and soreness.

Physical Examination.—Pale, dark under the eyes. Slight dulness down to the third rib in left top, also in left apex behind. Respiration a little jerky in this region, no

definite râle, but in the supra-clavicular space a faint "crumple" with full breath. Voice a little "nearer" in right apex. Temperature 99.8. Pulse 98. One month later the "crumple" had disappeared, but the jerky respiration continued. Respiration in right apex broncho-vesicular and voice faintly bronchophonic. In the lower right back, especially between the scapula and vertebral column, moist râles. During her stay of a little over two years she expectorated blood once, and the respiration in the lower right back became in a circumscribed area rather bronchial, but upon the last examination only faint dry râles could be heard after cough, with obscurity of respiration, but the percussion note had everywhere improved greatly. The temperature and pulse fluctuated from time to time, but at the last became normal. *No bacilli were found at any time.* Gain of twenty-seven pounds in weight.

Subsequent History.—For two years has felt perfectly well. One brother has since died of acute tuberculosis, but she has had no return of abnormal symptoms.

Case II.—(No. 33). Entered July 23, 1892. American. Age 19. Single. Worker in box factory. Family history negative. For some months weakness, cough with whitish starchy sputa, three times slight amount of blood; severe headache; night sweats, loss of flesh, dyspnœa upon exertion; occasionally feverish.

Physical Examination.—Except for slight increase in the expiratory murmur in the right apex in front, and broncho-vesicular respiration in the upper right back, little to be found in chest. Anæmia present, and sclerotics very clear. Temperature slightly elevated. Pulse rapid. Later, slight dullness developed in the right apex, and respiration was jerky. *Bacilli in sputa.* Occasional slight hæmoptysis occurred, but patient steadily improved, and at the end of two years left the hospital and is now very well. At the last examination there was little or nothing abnormal to find in the chest. Gain of thirty-four pounds in weight.

Synopsis.—Incipient phthisis at top of right lung. The patient was of very nervous disposition and, although the temperature never rose very high, it always was slightly elevated, and was just above normal towards the last.

Arrest of disease after a stay of two years. Patient has remained well since.

Case III.—(No. 36). Entered October 5, 1892. American. Age 22. Single. Clerk. Family history: mother, two aunts and two uncles died of phthisis. Never vigorous. Two months previous to entrance about a half cup full of blood was expectorated. Slight hacking cough with slight yellow expectoration. Loss of twenty pounds of flesh.

Physical Examination.—No dullness, but in both apices, in front and behind, rather coarse "clicks" with inspiration. No bronchial respiration. In left back, near spine of scapula, circumscribed area of slight broncho-vesicular respiration with increase of voice sounds. Temperature 100. Pulse 100. *Bacilli were found in the sputa.* The patient had occasional hæmoptysis, and the cough persisted for months, but at the end of two and one half years she left Sharon looking and feeling well and strong, the cough and bloody expectoration having disappeared; faint snapping râles in the apices still being noticed. Gain of seventeen pounds.

Synopsis.—Incipient phthisis at apices. Arrest of disease after two years' stay at Sharon. Patient has remained very well since, with no symptom of return of trouble (one year).

Case IV.—(No. 42). Entered January 25, 1893. Irish. Single. Age 25. Domestic. Never was strong. Family history: one sister died of phthisis, otherwise negative. Previous history of uterine trouble for which she was treated at the City Hospital; malarial fever and "la grippe" six months before entrance. Six months previously caught a severe cold; bad cough for four months, with muco-purulent sputa; pain in upper left chest and shoulder; palpitation; much loss of flesh, anorexia, dyspepsia; irregular and painful menstruation.

Physical Examination.—Slight dullness in right apex, lack of tone in both apices. Respiration obscure in apices, and a questionable "crumple" in the right top front and back. The patient, during her stay of nearly two years, improved greatly in general conditions; had one or two attacks of general bronchitis. At one time faint clicks could be heard in both apices, and whispered voice was in-

creased at these points. On account of the uterine condition, however, she was obliged to go to the New England Hospital, and later to the City Hospital, but previous to her departure all signs had cleared from the chest; the percussion was good throughout, and only an occasional dry "click" could be heard at the supra-clavicular space. Temperature 99.8. Pulse 94. *Bacilli were found in the sputa.* Gain of five pounds in weight.

Synopsis.—Incipient phthisis at both apices, with intercurrent attacks of acute bronchitis and complicated with severe uterine trouble requiring operations. Complete cessation of cough and expectoration and clearing of morbid pulmonary signs after a nearly two years' stay at the Sanitarium. No recurrence of pulmonary disease. Death following uterine operation about one year later.

Case V.—(No. 49). Entered July 27, 1890. Irish. Age 28. Single. Domestic. Family history bad; two brothers, two sisters and father died of pulmonary disease. History of illness five years before, with pain in the right side, but no cough, and was not in bed. Was told at the time by a doctor in Ireland that she had consumption and would not get well. Came to America three years before entrance and was well until two months previous when she had a hemorrhage without previous warning. Short cough with scanty sputa, malaise, loss of flesh, anorexia, pain in right chest.

Physical Examination.—Large frame. Tenderness at right apex. In middle of right back, slight dullness; respiration not so free as on left. Two months later moist râles developed over point of dullness in right back. Temperature 100. Pulse 88. *Bacilli and elastic fibres in the sputa.* Fourteen months later the patient left Sharon, having had no cough or expectoration for several months, and having been well, as far as general appearance goes, for six months. Splendid specimen of health. Gain of twenty-six and one half pounds in weight. The slight dullness in right back persisted, but the râles disappeared.

Synopsis.—Case of incipient phthisis in right lung with hemorrhages. Complete arrest of disease after fourteen months stay at Sharon. Patient perfectly well and strong up to the present time; "never so well in her life before." No sign of cough or ill health since leaving Sharon.

ARTICLE V.

THE TREATMENT OF TUBERCULOSIS WITH TUBERCULIN AND ITS DERIVATIVES.

By ALFRED WORCESTER, M.D.
OF WALTHAM.

READ JUNE 10, 1896.

THE TREATMENT OF TUBERCULOSIS WITH TUBERCULIN AND ITS DERIVATIVES.

THE medical profession has hardly begun to recover from the disappointment of the wild hopes aroused by the discovery of Tuberculin. The previous discovery of the bacillus of tuberculosis, the most important pathological discovery of this generation, has been overshadowed by the failure of tuberculin in satisfying inordinate expectations.

There is little to be gained in recalling the disheartening story of how consumptives in all stages of the disease were injected with hap hazard amounts of all sorts of tuberculin. Nor is there any special advantage in following many of these unfortunates to the autopsy table for the proof of their deaths from specific poison. For it is now well known that tuberculin not only will not restore the dying, but that it is an intense poison to tuberculous animals. But neither its lack of miraculous power nor its specific potency justifies its hasty abandonment in therapy. Indeed it would rather seem from its fearfully poisonous effects in the tuberculous, and from its absolute harmlessness in the non-tuberculous, that tuberculin is the agent or contains the agents desired in fighting this disease.

Before considering its possible therapeutic value let us for a moment think of its undoubted value as a diagnostic agent. However we may differ in estimating the curative powers of different remedies and methods of treatment,

there can be no question that it is in the earliest stages of the disease there is the greatest hope of success. This truism is especially applicable to parasitical diseases, like tuberculosis, where, by vegetable growth in the tissues, the infected parts of the body are progressively destroyed.

It was a mighty help given when Koch taught the world to recognize the bacillus of tuberculosis. But before the diagnosis can be made by the microscope it can generally be made without it. And while the detection of the bacilli makes the diagnosis certain, failure to find the germs does not exclude the disease. And in practice the microscopic report as to the sputa is of little use beyond furnishing a convenient occasion for the physician to acknowledge at least to himself what ought to have been recognized before.

The tuberculin test, on the other hand, is of far more help. For long before the destructive inflammation is apparent to sight or touch, and long before the deadly germs are thrust out in the excretions, an injection of tuberculin will discover their insidious presence. A negative result gives absolute surety, which of itself is often of incalculable value, and a positive result is like uncovering the smouldering fire in one's house walls before serious damage is done. The discovery is indeed serious, and for a moment it seems as if stirring up the trouble made it worse. But in neither case is ignorance bliss as regards the hidden foe.

The diagnostic value of tuberculin is easily demonstrated. Its curative value is a far more difficult question. Very few physicians had the courage to continue using tuberculin after their first terrible disappointments; but in the wards of the Berlin Charité, and in some of the European Sanitariums (at Rehburg, and at Turban's at Davos), tuberculin has been in constant use since its discovery; and in spite of its almost universal and bitter condemnation it must be admitted that some of the most painstaking and deservedly

famous members of our profession firmly believe in its great therapeutic value. Foremost among these scientists stands Professor Brieger of Berlin. To him we are especially indebted for what is known of the chemistry of Koch's tuberculin and of Behring's heil serum. His name stands worthily with theirs.

What little I can report to you to-day I owe first to Brieger's great kindness to me, a stranger, and I welcome this opportunity of publicly thanking him for his patient instruction and for his great courtesy in giving me free access to the tuberculosis wards and to the clinical records of his patients in the Charité Hospital. I am of course not at liberty to report others' work, but I desire to make plain that my own little experience with tuberculin is only in imitation of what I saw being done by Professor Brieger.

The diagnostic value of tuberculin, as is well known, is due to its poisonous effects upon the tuberculous when given in doses that produce no febrile reaction in the non-tuberculous. It is perhaps not equally well known, but it is no less a fact, that by daily injections of tuberculin in sufficiently small doses at first, and by careful increase of the dose, a tuberculous patient can be given an immunity to the poison of tuberculin quite equal to the immunity possessed by the non-tuberculous. The production and maintenance of this immunity to the poison of tuberculin constitutes the modern therapeutic method of using it, and I am one of those who believe that this acquired immunity to the poison of tuberculin is a great advantage to the tuberculous patient. But before passing to the question of benefit resulting from this treatment we may profitably inquire by what processes this immunity is acquired.

I suppose it may be taken for granted that tuberculin is formed in the tuberculous patient as well as in the culture media of the laboratory. And up to a certain time in the history of the tuberculous patient his body is able to with-

stand the poison excreted by the increasing bacilli. As the disease progresses this power of resistance increases up to a certain limit, during which time a non-febrile condition obtains, and then, when the natural power of accommodation is at last overstrained, the fell power of the poison is disclosed and the patient rapidly succumbs. During the apparently quiescent period, if the system suddenly be overtaxed in any way, by excessive fatigue or by the invasion of other germs, of malaria, of influenza, or of pneumonia for instance, the consequences are very serious. For so nicely adjusted are the resistant powers to the body's needs that the least extra burden is intolerable. Here we have a possible explanation of the poisonous effect of an injection of a minute amount of tuberculin into the body of a tuberculous patient. His body is accommodated to what its own bacilli produce, but cannot stand any more. But if this tolerance can be artificially increased by gradually increased demands upon the body's resisting power, a reserve force is secured. In other words, the immunity to tuberculin obtainable in tuberculous patients is just the re-enforcement needed.

It is claimed by some clinicians that pure tuberculosis causes no fever, and that the hectic which almost invariably accompanies the later stages of the disease is really caused by the invasion of other germs into and through the tuberculous tissues. This is a question far beyond my ability even to discuss. But however the hectic may be caused, inasmuch as the value of tuberculin depends upon so using it as not to cause any febrile reaction, its use is of course restricted to the non-febrile forms and stages of tuberculosis. For only in such cases is it possible to be sure that the tuberculin does not incite or at any rate maintain the daily fever.

This restriction makes it much more difficult to determine if the immunity to tuberculin obtainable in tuberculous patients is of any real value. For, as is well known,

the non-febrile cases often improve under treatment. Moreover, it is by no means a simple task to use tuberculin in this way. The closest watch must be kept, and the greatest care taken to eliminate all other febrile excitants, while immunizing the patient. And this very care would tend towards the patient's natural improvement. Again the faith and hope engendered by any form of treatment at the hands of a physician and nurses who believe in it is doubtless as large a factor as it is difficult of estimation.

Whether at home or in the sanitarium, patients under such treatment must have the great advantage of a regime in itself well calculated to effect their improvement. But all these difficulties, it may well be noticed, apply to the scientific determination of the value of the treatment, and do not affect the patient's interests. Doubtless the Guinea pigs will help in solving the question, and yet it has not been proved that what is true for Guinea pigs is also absolutely true for human patients. And after all, the real determination of tuberculin's value depends upon the slow accumulation of patient clinical investigations carried on not solely in the scientific spirit but with the ever present purpose of helping in every possible way each patient. Were it allowable at the same time to employ only one supposed curative agent, of course it would be far easier to determine the respective values of the different agents successively employed. But we can only add any new treatment, such as we are now considering, to the best possible combination of such other treatments as are already of supposed value. And the value of the new treatment can be estimated only as our experience with it compares with our previous experience. Considered in this manner one's own little experience is humiliatingly small. And after a year's work I find my confidence in the value of this new method of using tuberculin depends vastly more upon what I saw in the

Charité wards than upon the few cases I have treated in imitation of Professor Brieger's methods. My own experience, small as it is, has nevertheless confirmed my Berlin impressions into a positive belief in the great value of this treatment.

My patients were not of a class able to travel to distant and more healthful climates, but for many of them the hospital wards afforded far less comfort, and the hospital fare was far less appetizing, than that to which they were accustomed.

In fully reporting my year's work in treating tuberculous in-patients and out-patients at the Waltham Hospital, four cases, admitted during the past month, have not been under treatment long enough to be reported with any advantage, and need not be mentioned; but mention must be made of two cases in which neither tuberculin nor antiphthisin was used because the patients were evidently so near their death.

Thus, in one case, the patient died on the fifth day after entrance. And in another case the dying patient was sent home after a single week's stay in the hospital.

With the exception of these two cases, which were admitted without having been previously seen and under a misapprehension of their hopeless condition, tuberculin or antiphthisin was always employed, — tuberculin in five cases, tuberculin followed by antiphthisin in two cases, and antiphthisin alone in twenty-two cases. The general treatment was about the same for all. For the preceding five months a few tuberculous patients had been admitted to the hospital and treated by the Carasso method. Three of these patients were turned over to my care June 1, 1895. My colleagues had already found it necessary to modify the Carasso treatment somewhat, on account of the drunkenness caused by the amounts of alcohol which he advises and also on account of the stomach disturbances caused by

his creasote and peppermint mixtures. But the inhalation of peppermint had proved so soothing that it has been generally employed ever since. Both the oil and the essence of peppermint have been used for inhalation, but few patients have been able to bear the oil. The Carasso mixture of creasote, peppermint, alcohol, chloroform and glycerine has been helpful, and except in a few cases has been well borne. Occasionally opiates, phenacetine, quinine and a few other drugs have been given for ephemeral reasons.

All patients have been given so far as was possible the regular hospital diet supplemented with milk and eggs, and also by wines and whiskey, or brandy, as the occasion seemed to demand. Encouragement has been given in the matter of deep breathing, in keeping out of doors whenever possible, and in coughing as little as possible.

Great care has been taken to minimize the danger of auto-infection as well as the infection of others. Clinical thermometers have always been specially cleaned in carbolic acid solution. The use of spit cups filled with carbolic acid solution has been required. Each patient has also been required to rinse the mouth and gargle with a Benzothymol solution before eating or drinking.

These precautions and these particulars of the regimen employed are here related merely to complete as far as possible the clinical histories which follow. The longer the duration of the disease the harder it is to give to others the clinical history, or indeed to keep it before one's own mind. Each day's story must be recorded in full, and besides there must be such a recapitulation as may be seen at a glance.

Observations of the temperature, pulse and respiration rates have been made every two hours by day and every four hours by night, if the patients were awake. These frequent observations are necessary in estimating the extent of the daily hectic and in testing the treatment. By means of symbols for the different medicines, I also show upon

the charts the exact times of their administration. When each day's story is charted with such detail, a summary chart is also necessary upon which the abscissas represent each a whole day instead of two hours.

Upon the two-hour chart is shown the temperature curve of each day, and the area bounded by this curve and the 99° line (determined by counting the squares enclosed) gives the product of the excess of temperature by its duration, in other words the amount of daily fever. By transfer of these daily amounts to the summary chart the curve obtained gives at a glance the general run of the fever. Upon this summary chart the frequently varying amounts of tuberculin or of its derivatives is shown and also the number of ounces of food ingested each day. Still another curve shows the patient's weight as taken weekly. In describing the conditions of the lungs, it is much plainer to represent the dullness and the râles, etc., by means of symbols drawn upon a skeleton chart of the chest than by words however well chosen.*

In summing up my experience with pure tuberculin,† which I have employed in the treatment of seven patients, I have to report that in two of these cases (I. and II.) there was so much difficulty in establishing a tolerance of it that antiphthisin was used instead. Although in several instances too large doses were given, no permanent harm resulted. In one case (II.) where by mistake a dose of .2c.c. was given where .002 c.c. had not been tolerated, there was a most severe reaction lasting for several days. But afterwards, under antiphthisin, the same patient made as absolute a recovery as it has been my fortune to witness. Only once was there failure in maintaining the requisite aseptic

* Summary charts, as here described, were submitted for each case reported.

† I have used the tuberculin made by Koch's manufacturers, Messrs. Lucius, Brunig & Co., whose agents in this country are Messrs. E. Koechl & Co., New York.

conditions for all hypodermic medication. I did not notice quickly enough a clouding of the tuberculin solution, and the four patients injected that day had resulting abscesses which lasted for several weeks. Two of these seven patients have removed far from my observation, one to Ireland (III.) and one to North Carolina (IV.). Both improved under treatment, and, according to reports received, have continued to improve ever since. One (I.) is still under the antiphthisin treatment, and has not done more than to hold her own. Two of the five cases where only tuberculin was used have so far recovered as to be practically well, having returned to their former occupations: one (V.) in the watch factory, the other (VI.) in her home. A third (VII.) has improved greatly in spite of a severe malarial attack. He bids fair to make a practical recovery. Four (I., III., IV. and VI.) of these patients were in advanced stages of the disease. Their lives had been despaired of by their physicians and friends. From previous experience I should not have expected any one of them to have lived so long as they have.

If, as is possible, these results might have been obtained without tuberculin, then I have been very remiss in the past—for many a consumptive, when first under my care not so sick as were these patients, has drifted steadily on from bad to worse until released by kindly death from wasting and suffering I was powerless to relieve. And if now it is by no reality, but only by a delusion of both physician and patient, that despair has given place to hopefulness, then am I still thankful for my delusion which I shall none the less strive to share with my professional brethren. For it is better a physician should be a deluded optimist than a scientific pessimist.

Another possible explanation of the apparent benefit resulting from the use of tuberculin and its derivatives depends upon the supposed germicidal power of tuberculin.

If it is true that each organism excretes its own specific poison (and that, just as acorns will not germinate in oak leaf mould, nor pine seed in rotted pine needles, while either soil is fit food for the other seed, so it is true that the bacilli excrete particular poison each for its own kind), then it is possible that tuberculin contains, besides the poison that affects the animal preyed upon, a specific poison also for the bacilli themselves. This theory has apparent support in the fact that tuberculin is the substance in which tubercle bacilli not only have ceased to grow but have actually died. If, as is claimed, it can be shown that the death of the bacilli is caused not by the exhaustion of all their proper food in the culture medium, but rather from the excretion into it of their own peculiar poison, then we may reasonably hope for the isolation of that particular poison.

The ideal remedy for a parasitical disease is a specific poison for the parasite, but absolutely harmless for the animal. We want something that will kill the bacilli of tuberculosis in the tuberculous patient, and yet not injure the patient in any way. Professor Edwin Klebs claims that this desired remedy is furnished in his antiphthisin which is stated to be a chemical modification of tuberculin containing all the germicidal and curative principles without the toxins. His claim has been bitterly disputed, but it has also been supported by many, and notably by the commission appointed by the Parish Medical Society of New Orleans for its investigation.

Inasmuch as the preparation of antiphthisin is declared to require such exceptional skill as practically to preclude its manufacture except under the immediate oversight of its discoverer, and as Professor Klebs himself is understood no longer to be in charge of the laboratory furnishing it, it must at the outset be admitted that there are grave uncertainties in its use. Although Professor Klebs's name will

forever be associated with the bacillus of diphtheria, yet the great work of his life has been upon tuberculosis. His antiphthisin is one of many derivatives of tuberculin which have been and are still being used. Indeed, in the Charité wards, tuberculin derivatives which Professor Koch and Professor Brieger are not yet ready to announce to the world are being used with great success, it is understood. Professor Klebs himself has previously furnished another derivative—tuberculocidin—which is said to possess some value. And it is to be hoped that ere long such definite explanations of the exact compositions and methods of manufacture of the tuberculin derivatives will be furnished as will obviate the present reluctance of many physicians to employ these agents.

It is only fair to state that Professor Klebs, in furnishing antiphthisin to the profession, stipulated that it should be used only in the non-febrile or early stages of tuberculosis. He has never claimed that its curative value could be otherwise demonstrated. But he has also stated that sometimes in the advanced stages antiphthisin retards if it does not arrest the course of the disease. And, furthermore, he claims that it never does any harm.

From this very fact of its harmlessness, which, so far as I know, is conceded by all who have used it, very naturally it has been used in the advanced stages of the disease as a last hope—where the daily fever precluded the use of tuberculin. Comparison between the two is thus much more difficult than would be the case if both agents were used under like conditions; and it needs not the saying that its failure to relieve in the advanced stages of the disease does not disprove its therapeutic value. On the other hand, if by using antiphthisin in the advanced stages any relief or arrest is obtained, that is strong supporting evidence of Klebs's claim of its worth in the incipient stages.

Of the twenty-two cases which I have treated with

antiphthisin, ten of them (VIII., IX., XI., XIV., XV., XVI., XVII., XVIII., XXII., and XXV.) were in such advanced stage of the disease that if no one of them improved it still would be little discredit to the treatment. But in four of these advanced cases (VIII., XVII., XXII. and XXV.) there was marked improvement; while of the five that did not improve in only one case (XV.) was the treatment carried out for more than a week or two. Were my experience with antiphthisin confined to these ten cases I should be thankful for having had it; for otherwise I should not have had the courage to have tried even to arrest the progress of the disease. Of course, there is always the doubt as to the correctness of the prognosis, intensified in my case by my lack of any special training or knowledge in diseases of the chest. It is, therefore, proper to add that in making these prognoses, or, what is the same thing, in estimating the extent of the disease, I have had the great advantage of the kind assistance of many brother physicians, whom I should here publicly thank were it not for the fear of involving them in these not yet generally accepted methods of treatment.

Nine of the cases (X., XI., XIII., XIX., XX., XXI., XXIII., XXIV. and XXVI.) were not so far advanced. Improvement would naturally be expected to follow any treatment of any use whatever in tuberculosis. But of these nine none have shown such special improvement as was hoped for. One (XXVI.) has shown no improvement. The others have made some gain for a time, but at least three (X., XXI. and XXIII.) have not held what gain they at first made. Had they remained longer under treatment in the hospital, possibly they might have continued to gain.

So far then as my small experience goes, the patients who have obtained an immunity to tuberculin do better afterwards than the patients who have been treated only with antiphthisin.

One of the claims made for antiphthisin is that it is serviceable in reducing enlarged cervical glands of tubercular origin. I have employed it in three cases, presumably of this character. In one the glands had already begun to suppurate. For four days .5 c.c. was given each day, without causing any reaction. The suppuration, however, rapidly increased, and the abscess was treated in the usual surgical manner. In the other two cases the marked improvement that followed, if not due to the treatment, was at any rate very different from anything within my previous experience. Not only did the deformity disappear but the general health rapidly improved, and in one case a marked daily fever soon ceased. Another claim for antiphthisin is that in cases of tubercular ulceration of the cornea its healing effects can be directly seen. I have tried it in one case (VIII.) of corneal ulceration in an advanced phthisical patient. Rapid improvement and complete healing followed, but before its use, under the ordinary treatment for corneal ulcers, improvement had evidently begun. Although the patient has hardly held his own generally, the corneal cicatrix has grown less and less.

Case I.—Mrs. R. A., thirty years old, had been treated in hospital by my colleagues for four months previously. She had gained wonderfully—in weight from 100 to 113½, and from helplessness in bed was now able to walk out of doors. There was still daily fever, considerable cough and expectoration in which were plentiful bacilli tub. Both apices were dull, and on the left the dullness extended below the second rib. Over these areas were fine moist râles.

On June 9th tuberculin treatment was begun with .001 c.c. This was gradually increased until July 17th, when .15 c.c. produced a severe reaction. The daily dose was diminished, but no immunity was obtained, and on September 9th antiphthisin was employed, beginning with 0.1 c.c. By November 1. c.c., and by January 2. c.c., was being given each day. This was continued with few intermissions until she was allowed to go home April 1st, over 300. c.c. in all having been given.

She then weighed 106 pounds, or 6½ pounds less than she did ten months before, but still 6 pounds more than on entrance. The fever, however, had not been absent for more than a few days at a time. Her appetite and general condition were good, her cough was less, and there were fewer bacilli tub. to be found in the sputa.

At times the lungs seemed much clearer, but again, perhaps from a slight cold, the râles would return to the diseased upper lobes.

For a month at home she continued to feel pretty well, but in May, after a severe cold, she returned to the hospital with a severe pleurisy in the left lower chest. It seems doubtful if an arrestment of the disease has yet been obtained.

Case II.—Miss H. S., age forty, family history negative, broke down in health six years ago. Had profuse hæmoptysis. Under rest and forced feeding gained strength and health. During the spring and early summer of 1895 she lost ground. Her voice became husky, she coughed considerably, and felt wearied. She had not lost weight. She began out-patient treatment August 19, 1895.

Tuberculin in doses of .0005 c.c. produced a marked reaction. And after a month's trial the attempt to obtain immunity was abandoned, a dose of .004 having caused a severe febrile reaction. Antiphthisin was then given, the dose soon reaching 0.2 c.c. Immediate and marked improvement followed.

But on October 26th, by mistake, .2 c.c. of tuberculin was given instead of antiphthisin. For twenty-four hours her condition was alarming, and for several days afterwards she was very ill.

On November 18th treatment with antiphthisin was resumed. At first a slight reaction followed the administration of 0.1 c.c., but soon 1 c.c. produced no reaction.

For a few days the last of December she had a severe cold, from which she rapidly recovered. By the end of February, when I discharged her, her cough had practically disappeared, and no bacilli could be found in her slight expectoration.

No râles could be heard, but instead, over both apices, loud blowing respiration.

She has since continued in vigorous health.

Case III.—Miss B. S., a servant girl, had been in the hospital since February 18, 1895, and had been sick for about a year when placed in my charge June 1st, 1895.

She had already improved considerably, having gained seven and a half pounds in weight; but her daily fever was constant. Her upper lobes, both right and left, which at first were full of all kinds of râles, had already become clearer. On June 15th, tuberculin was begun with a dose of .001 c.c. At each increase of the dose a marked febrile reaction followed, generally most marked on the second day. But by August an immunity to .1 c.c. was obtained equal at least to her immunity to .001 c.c. two months earlier. 3.27 c.c. in all was given. During this treatment her general health continued to improve, her cough and expectoration lessened, her weight remained practically the same, being only one pound more at the end of the two months. She left the hospital to return to her home in Ireland where at last accounts she was doing well.

No distinct change in the condition of her lungs had occurred nor in the number of bacilli tub. in her sputa while under the tuberculin treatment.

Case IV.—Mrs. G. L. D., 39 years old, entered the hospital July 12, 1895. Family history negative. Began coughing in October, 1894. Confined in December. Recovered well. Had the grippe in February, was in bed a fortnight, and did not recover her strength. Her cough increased and her weight decreased. Very nervous, appetite poor. Free expectoration contains many bacilli tub. Profuse night sweats. Complexion dusky. Daily fever. Upper right lung extensively diseased.

The tuberculin treatment was begun July 15th with a dose of .002 c.c. With many intermissions, and many changes in dosage, the attempt was made to obtain her immunity to it. By October this seemed to have been effected, and she was transferred to the out-patient department. But this did not work well, for she was unfit to take care of her children. The treatment was often omitted; and when early in November, after a week's intermission, the accustomed dose was given there followed a sharp reaction, but by increasing the dose each day the fever again disappeared.

Meantime her cough decreased. She gained five pounds in weight, and became a much healthier looking woman. In December she went with her family to North Carolina to live, where she has continued to improve.

Case V.—Miss K. D., 26 years old, entered the hospital July 31st, 1895. Family history negative. For three years she had been working in the watch factory, but in March had been forced to give up work because of a cough following a severe cold and an attack of the grippe. She had been visiting for a few weeks just past in the country, but had been steadily losing strength. Menstruation regular. Appetite very poor. Moderate daily fever.

The upper right lobe was dull on percussion, little air entering it. Subcrepitant and moist bronchial râles were plentiful. She weighed 84 pounds.

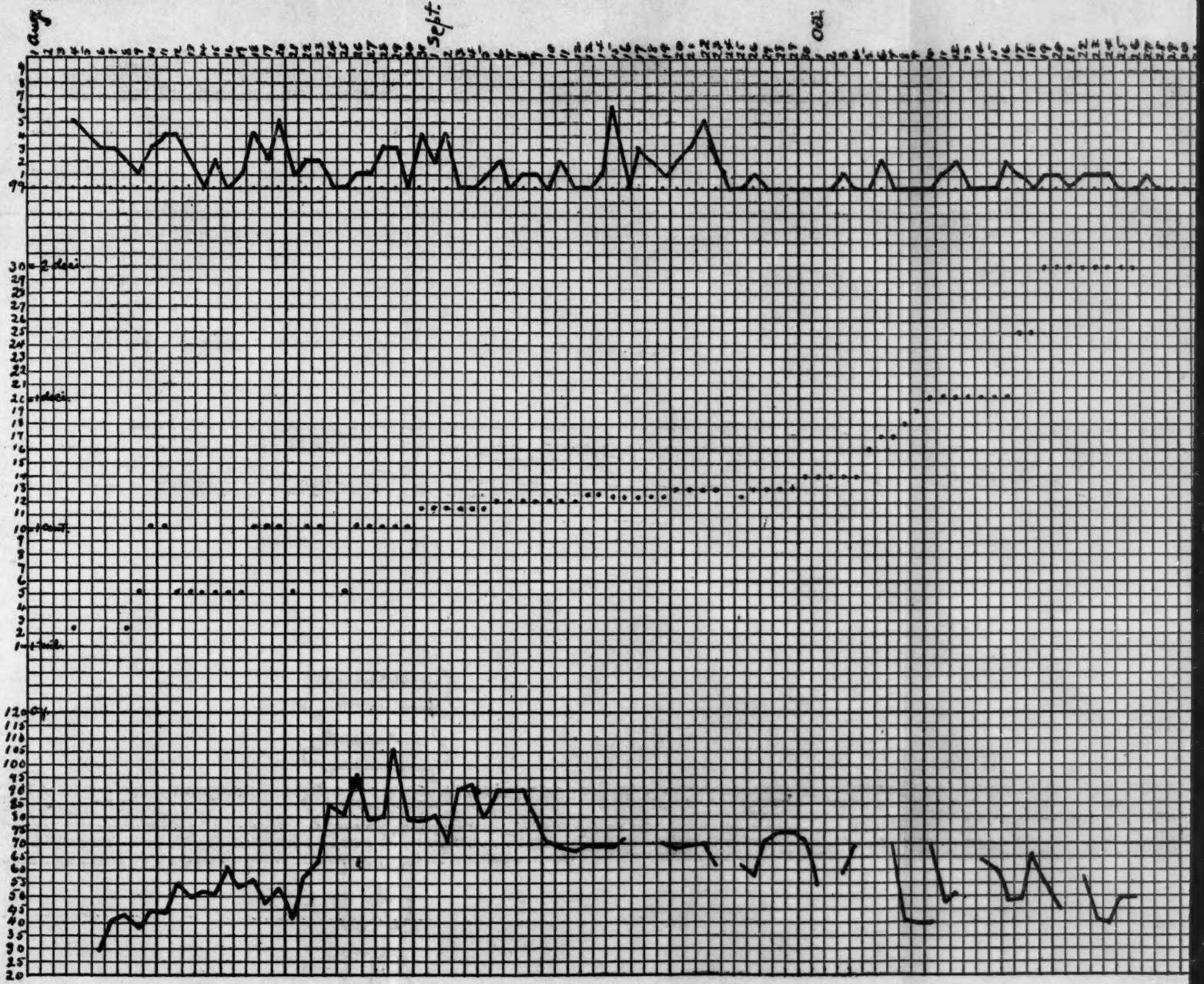
She stayed in the hospital fifteen weeks, during which time she gained 9 pounds. She was given daily injections of tuberculin, beginning with .002 c.c. and reaching .2 c.c. in fourteen weeks. The fever disappeared, but after an intermission of two weeks when the injections were resumed in the out-patient department there was a slight fever again for a few days. The injections were continued until December 5th, 9.83 c.c. of tuberculin having been used.

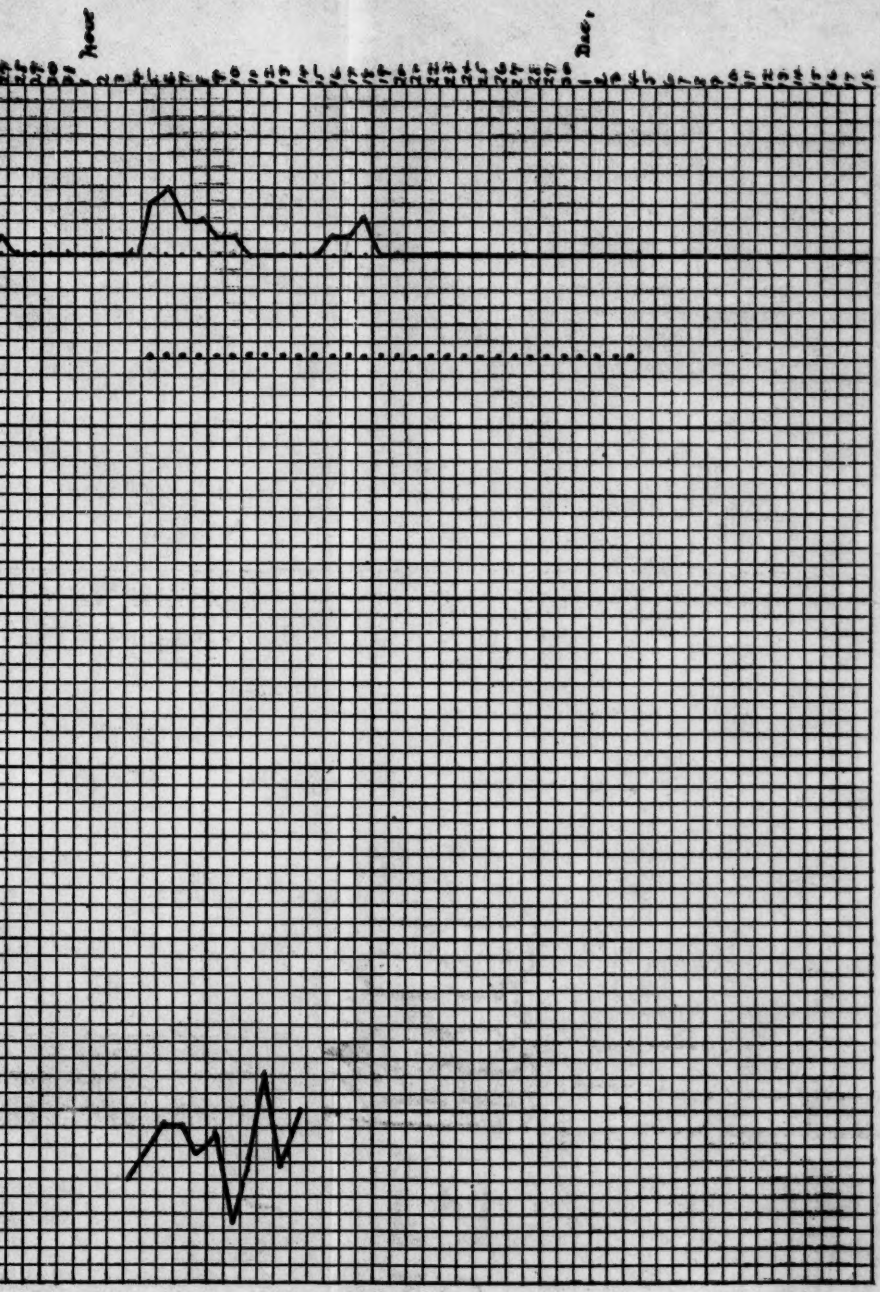
During treatment her cough so nearly disappeared that many days elapsed without obtaining any sputa for microscopical examination. At first the bacilli tub. were plentiful but towards the end were rarely found.

The diseased lung cleared up wonderfully, at times being almost entirely clear of râles. Her chest inflation increased from 1¾ inches to 3 inches. She returned to the watch factory January 1st, 1896, and except for a few days absence in March on account of a severe cold she has kept steadily at work. Since then a slight cold has persisted, at times râles are still to be heard and bacilli tub. are found in the sputa. But her general condition is now vigorous. Although lighter by three pounds than when she left the hospital, she weighs as much as she did before her sickness began. (See Chart V.)

Case VI.—Mrs. C. D., age 34, had been treated in the hospital for seven weeks previous to my taking charge. She

CHART V.




Hour
Day

had been ill for one or two years, having had many attacks of hæmoptysis—some of them quite severe. She had been confined in February last for the ninth time. She had gained rapidly under hospital treatment, although still confined to her bed. There were still bacilli tub. in her sputa. Over both apices there was dullness and prolonged expiratory sounds with a few medium moist râles. Coughing not troublesome, expectoration scanty, appetite very good.

Treatment with tuberculin was begun June 9th, with .0005 c.c. Immunity was soon obtained, the only serious reaction occurring July 19th when the dose was increased from .15 c.c. to .2 c.c. Six days afterwards the same increase produced only a slight reaction, and this dose was continued daily with fever intermissions until December 13th, 76.77 c.c. in all having been given.

Early in July she was persuaded to leave her bed, and soon after to walk about out of doors. On August 15th she was transferred to the out-patient department. The walk of a mile each day soon became easy, and by October she resumed her work taking the whole care of her family. She regained and surpassed by several pounds her previous best weight. Her cough disappeared, except for occasional colds, and her sputa became free of bacilli tub. During the winter, while doing all her work, and often with her children sick she ran down somewhat. After a severe cold this spring there has been a slight return of her cough. But she is so well that it has not been possible to persuade her of the necessity even of medical observation. Her left lung seems entirely clear, and at the apex of the right lung there are fugitive râles of a dry explosive character. Under treatment her chest inflation increased from 3 to 4½ inches.

Case VII.—H. P., a laborer, 56 years old, entered the hospital March 5th, 1896. Family history negative, except that his wife and children, according to his story, were all tough. Well till January, when, with an attack of grippe a cough began, which has persisted. No appetite, and daily fever.

The upper lobe of the left lung was well filled with coarse and fine râles. Bacilli tub. in sputa. On March

12th he was given .01 c.c. of tuberculin, and the next day .05 c.c. without causing any reaction. On March 16th .1 c.c. of tuberculin caused some reaction, but for the next fortnight the same dose caused no reaction. In April he was given .15 c.c. daily and except for a sleepy feeling in the afternoons he experienced no effect. His fever entirely disappeared. He stopped coughing, and gained 13½ pounds in weight. After April 8th, he was an out patient. All went well till May 14th, when he had a severe attack of malaria, which he had had before. Under heavy doses of quinine this was checked, but returned ten days afterwards. A slow fever, apparently typhoid, followed, and he is now in the hospital again. (See Chart VII.)

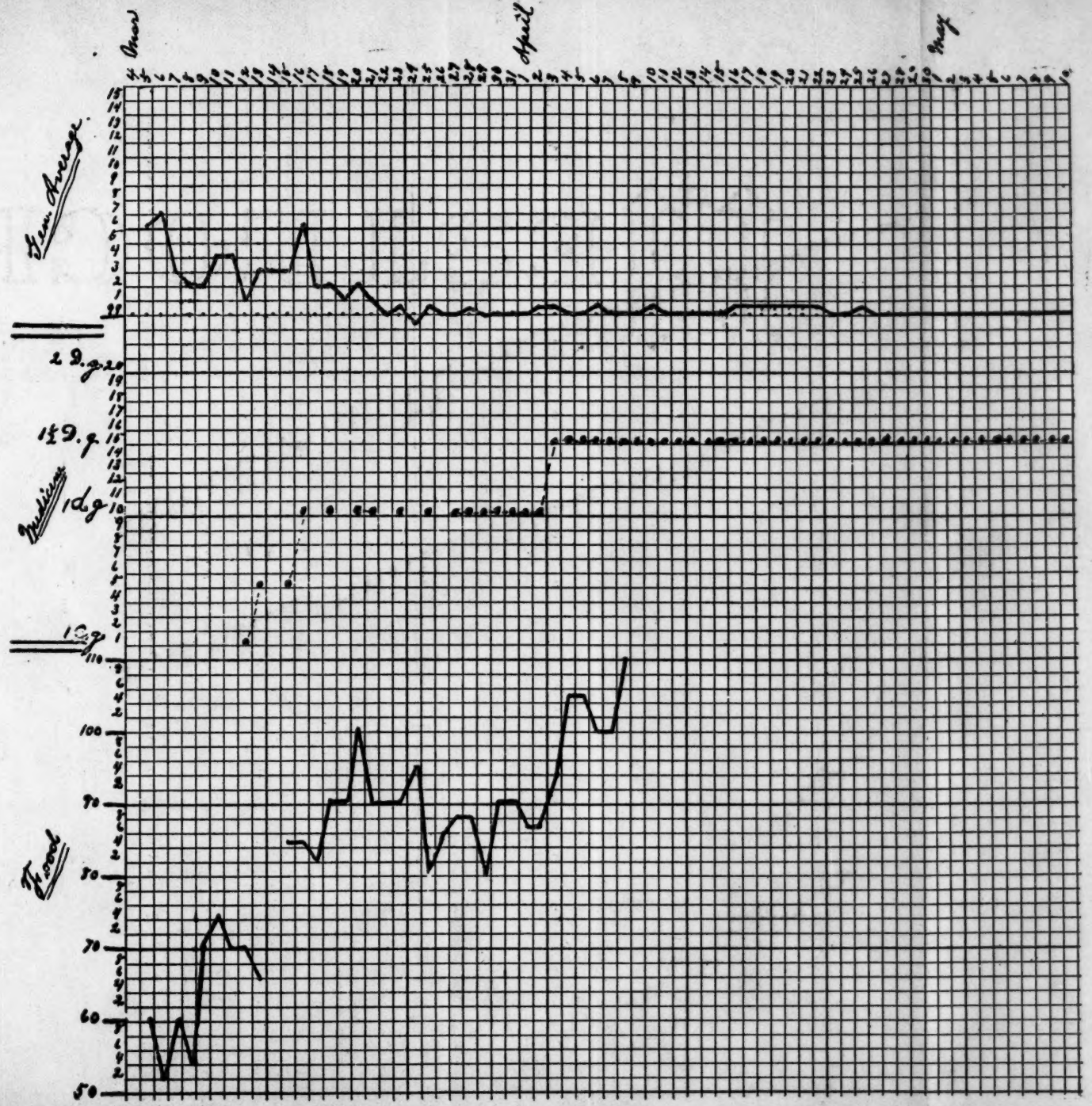
Case VIII.—W. G., twenty-four years old, entered the hospital December 26, 1895. Several of his family are phthisical. He has been sick for several years, and returned from Arizona in May, 1895, because he was so rapidly failing there. Last summer in Nova Scotia he gained a little strength. In the autumn he lost rapidly, partly because housed with a severe corneal ulcer. It was on this account that he was admitted to the hospital, and his eye soon became as well as ever except for the corneal cicatrix.

Both lungs were diseased. There was slight daily fever. Coughing excessive. Bacilli tub. in sputa.

On December 30th antiphthisin was begun in 1 c.c. doses. In February, after ten days, at 1.5 c.c. the dose was increased to 2 c.c. There was marked improvement. He gained rapidly in weight, his fever disappeared, and his cough slackened. The first week in March he had a hard time with an ulcerated tooth, but his general improvement was at least maintained until May, when he began losing ground—coughing more, eating less, and suffering from backache. By the end of the month, however, he had begun to mend again, and is now in about as good condition as a year ago, when his admission to the hospital was refused on the ground that we thought he would inevitably die very shortly.

Case IX.—G. M. M., thirty-one years old, came to the hospital December 5, 1895. One brother died of phthisis fourteen years before, and last year his own little son died of tubercular meningitis.

CHART VII.



He had been strong and healthy till March, 1894. Has not worked since February, 1895. Used to weigh 145 pounds. Now weighs 117. Cough is bad. Appetite fickle. Some daily fever.

Both lungs extensively diseased. Bacilli tub. in sputa. He was given antiphthisin in doses of 0.5 c.c. two days, and when it was increased to 1 c.c. the fever also increased. He remained under treatment only two weeks, "because no assurances of his recovery could be given him." No reports of his subsequent condition have been received.

Case X.—Mrs. S. C. G., twenty-one years old, entered the hospital November 28, 1895. She was then seven months pregnant, and her labor was threatening. She was intending to be treated for tuberculosis of the left lung. She had been coughing for several months, and recently by examination of the sputa the diagnosis had been made. The physical signs were few, and confined to the left nipple region where fine moist râles and prolonged expiration could be heard. There was no fever.

Antiphthisin was given daily. Her appetite increased, her cough distinctly lessened. Owing to her father's sudden death she returned to her home where, after a normal confinement, the antiphthisin treatment was resumed. But she failed rapidly, and has continued to fail after being moved South. Later reports are even more unfavorable.

Case XI.—Mrs. H. V. G., forty-two years old, had hæmorrhages, presumably from the lungs, when a girl. She has had nine children, the last one having died of tubercular meningitis, aud the preceding one at two years old of well marked phthisis. An older child is nearly blind from corneal ulcerations. For several years past she has had severe sickness, always attended with cough and generally with hæmoptysis. During the past year she has grown much worse. Her appetite was poor. There was a sharp daily fever. The left lung was diseased throughout.

On November 29th 0.5 c.c. of antiphthisin was given, and soon the daily dose was increased to 1 c.c. She was unwilling to remain in the hospital after a fortnight, and the treatment was continued at her home until January 9th, when the hopelessness of obtaining any relief became so apparent that the antiphthisin was given up. She has since steadily declined.

Case XII.—Mrs. R. J., forty-five years old, had had lung trouble since girlhood. Before her marriage, twenty-five years ago, she had several severe attacks of hæmoptysis, and was supposed to have only a short time to live. Her four children are in the main healthy, although one has had suppurating cervical glands, and another has chronic middle ear suppuration.

Within the past twelve years Mrs. J. had had several exacerbations of her cough. Each time her life seemed threatened. During the past year she had steadily lost strength. Her appetite had gone, and, for the first time, her courage also. Her cough was troublesome. Her sputa contained bacilli tub. There was daily fever. With difficulty she was urged to undergo treatment with antiphthisin. On December 9, 1895, 0.5 c.c. was given. The fever soon disappeared. The dose was increased to 1 c.c. on December 17th and continued daily till February 28th, when she was discharged in greatly improved condition. Her chest inflation had increased from $1\frac{1}{2}$ to $2\frac{1}{2}$ inches; her weight from 106 pounds to 108 pounds. Her cough had diminished, her appetite and courage had returned.

Her left lung on entrance was almost useless, taking in little air, and being full of coarse moist râles from apex to base. The apex of the right lung also was full of fine moist râles.

At the time of her discharge the right lung had cleared entirely, the left lower lobe had become nearly clear, and the left upper lobe had lost the fine moist râles. Dry medium râles had taken their place, and much more air entered the lung. Since then she has continued to improve in weight and strength, and is now about as well as at any time for some years.

Case XIII.—W. H., a student, nineteen years old, entered the hospital March 27, 1896. His mother had died of phthisis the year before. He had been fairly well till last summer, when in the West he had malaria. During the autumn his college work grew more impossible. His appetite was poor, and he was completely tired out. After resting at home for the winter he was worse, coughing more. Bacilli tub. in sputa. Moderate daily fever. His right upper lung well filled with fine moist râles.

On April 1st antiphthisin was begun in doses of 0.5 c.c., increased to 1 c.c. on April 26th and to 1.5 c.c. May 7th, 32 c.c. in all having been given up to the time of his discharge, May 14th. The treatment is being continued in the New Hampshire hills, where he is to spend the summer in camp.

During his stay in the hospital he gained 4 pounds, but no other improvement was noticeable.

Case XIV.—K. E. R., male, 21 years old, entered the hospital Feb. 13, 1896. Both parents and one sister died of phthisis. When 13 years old he had pneumonia and was sick a year. Has worked in cotton carpet mill and in box factory, and for last five months as electric car conductor. Progressive weakness with loss of appetite and dyspepsia compelled him to stop work.

Lung lesions not very marked; a few bronchial gurgling râles in upper right, and more of the same with sub-crepitant râles in the upper left lobe. Bases clear. Respiration not embarrassed. Cough moderate. Few bacilli tub. in sputa. Great distress in stomach directly after eating. For a week he was kept in bed and fed entirely upon peptonized liquid food. There seemed to be some improvement. On the 10th day after entrance a 0.5 c.c. of antiphthisin was given, and on the same day he was given solid food and allowed to sit up. He was the worse for it. Four days afterwards 0.5 c.c. antiphthisin was again given each day for seven days, and again after two weeks interval it was given in 1 c.c. doses for five days; and both times there occurred an increase of fever, whether due to the antiphthisin or to other causes is not clear.

His stomach distress increased, a troublesome diarrhœa began, and in every way he failed while under treatment. He was accordingly removed to a Home for Incurables where he soon afterward died.

Case XV.—Miss C. H. a delicate girl of 18 years, entered the hospital Feb. 29, 1896. Her brother had died of phthisis three years before. For three preceding winters she had been very sick, with pneumonia it was said. During the summers she had been well enough to be out of doors, but for six months past she had failed noticeably in every way.

Menstruation absent. Cough troublesome. Bacilli tub. in sputa. Appetite very poor. Daily fever often reaching 104°. Both lungs were diseased, but only very fine moist râles could be heard.

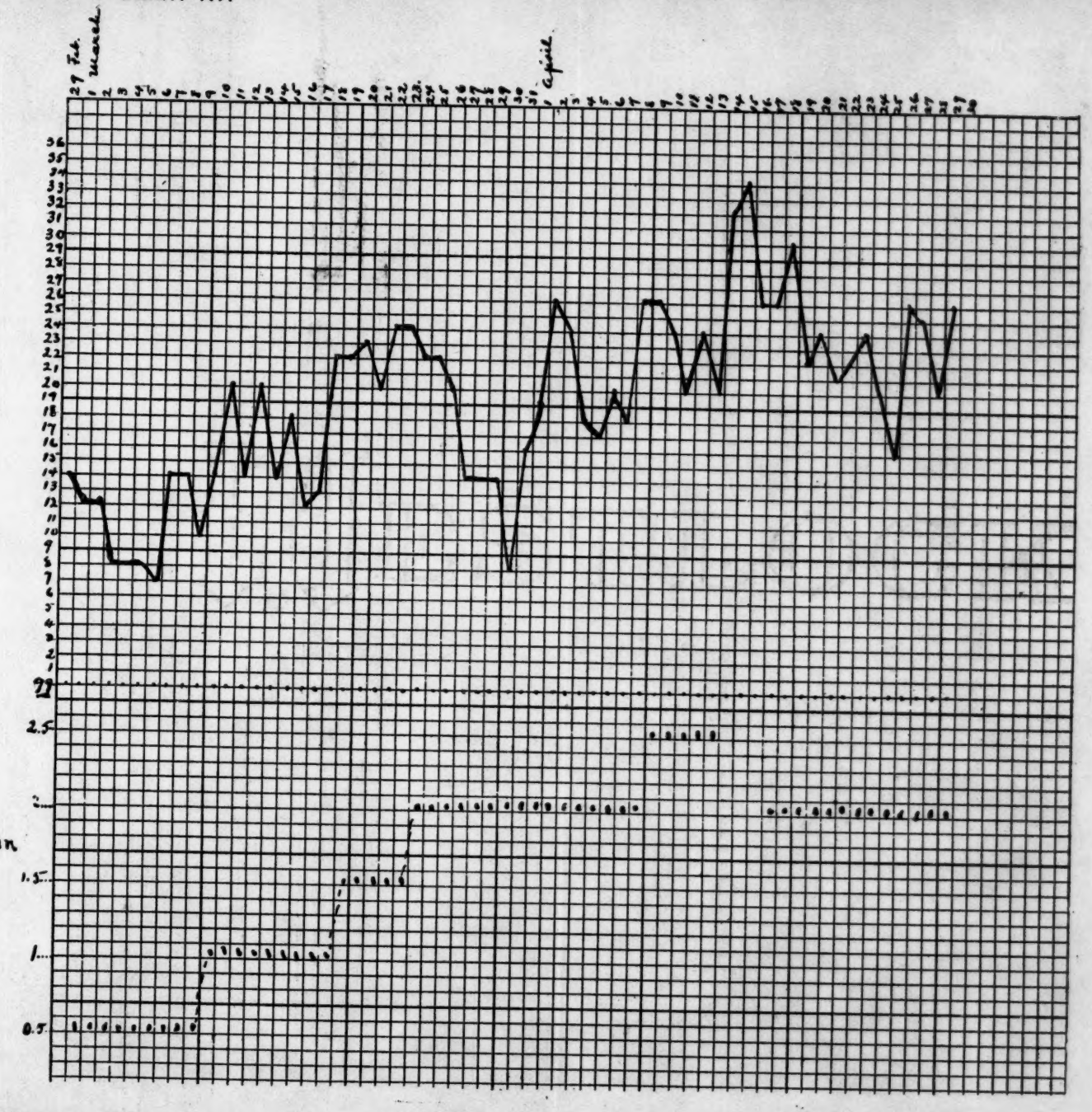
Antiphthisin was given in doses of 0.5 c.c. for ten days, and then increased to 1 c.c. for ten days, and then 2 c.c., and once for four days 2.5 c.c. was given. 91.5 c.c. in all was given during her two months stay in the hospital. Her fever was continuously high, and was worst during three days when no antiphthisin was given. She lost 2 lbs. in weight. Her left lung began breaking down. And in every way she failed while under treatment. (See Chart XV.)

Case XVI.—L. J. C., 38 years old, entered the hospital Dec. 12, 1895. Family history negative, but a consumptive patient lived in his family three years ago, in the room which he himself has since occupied. For three years he has had a stomach trouble, and for two years has coughed with scant intermission. Has not been able to work for about a year. Daily fever. His lungs did not show much disease, although his cough was persistent and the sputa well filled with bacilli tub. His stomach rebelled at every attempt to push the diet. On December 25th and for a week following, 0.5 c.c. of antiphthisin was given daily. The fever was much higher, but soon declined and continued to decline when the dose was increased to 1.5 c.c. For three days 2 c.c. was given, and again there was a sharp rise at first and as sharp a decline the two following days with the same dose. But his stomach was so rebellious that all hope was given up. He went home to die, and lived only a few weeks.

Case XVII.—K. J., a weaver, 35 years old, entered the hospital Dec. 9, 1895. Family history negative. For a year has been losing health and strength. He has lost 40 lbs. in weight. Appetite poor. Coughs almost continuously. Sputa rich in bacilli tub. No fever. Both lungs extensively diseased.

Antiphthisin treatment was begun December 11th, with dose of 0.5 c.c. This was soon increased to 1 c.c., and in a month to 1.5 c.c. Rapid improvement followed. His appetite and weight increased, as his cough diminished.

CHART XV.


Fever
Antiphthisin
27 Feb.
1 March
31 April
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35
34
33
32
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28
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25
24
23
22
21
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7
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5
4
3
2
1
2.5
2
1.5
1
0.5

After February 10th, 2 c.c. was given daily. During March a few doses of tuberculin were given which produced a sharp reaction. Antiphthisin was then resumed. April 1st he returned to his home, where although continuing the antiphthisin treatment he has not done so well.

While in the hospital his lungs cleared up considerably, some portions becoming entirely clear of râles, and the more seriously damaged portions containing fewer râles. He felt so well and strong that he could no longer bear not being at home and at work.

Case XVIII.—C. J., 21 years old, came to the hospital an out-patient Dec. 31, 1895. His history is not definite, more than that he had been sick for several years. He was emaciated and very weak. Coughing almost continuously and expectorating freely. Sputa rich in bacilli tub. Considerable daily fever.

Both lungs were diseased throughout. His sisters were told that it was useless for him to come to the hospital, but as he was determined to make the effort he was given the antiphthisin treatment beginning January 13th with 0.5 c.c. February 10th this was increased to 1 c.c. and this amount (31 c.c. in all) was given for two months with many intermissions when he was not able to come to the hospital. He improved for a time, in spite of the continued fever. In appetite and general strength, in courage and comfort, there was such a change for the better that his friends became hopeful of his recovery. He himself unwittingly embarrassed us by hunting up other despaired-of consumptives and urging them to apply for the same treatment.

At first there was a gain of 3 lbs. in weight, but this was lost in the next two months. And since he discontinued coming for treatment his strength and weight have fallen off rapidly.

Case XIX.—Mrs. M. L., thirty-eight years old, came as an out-patient Jan. 2, 1896. Her brother died of phthisis at her home thirteen years ago; and her two-year old daughter died of tubercular meningitis the following summer. Another brother has phthisis. Her children are well. She had been very well and strong till the autumn of 1893.

She then had pertussis and the cough has persisted. From October, 1894 to June, 1895, in Asheville, she gained strength, her only medicine being daily walks over the hills. During the summer and autumn of 1895 she failed.

Her general appearance was healthy, but there was a steady cough with bacilli tub. in the sputa, and a slight daily fever.

Her right upper lung was extensively diseased, a well marked cavity being surrounded with râles of all sorts and sizes.

On January 7th the antiphthisin treatment was begun in doses of 1 c.c. This was increased to 1.5 c.c. February 10th, and to 2 c.c. March 12th.

She walked two miles to the hospital every day, regardless of weather. And after five months, having taken 152 c.c. of antiphthisin, her condition is somewhat better than at this time last year on her return from Asheville.

Her weight is about the same, or a few pounds more. Her general condition is improved. Her cough is less. The cavity in her lung is plainer, but the surroundings are clearer of râles. More air enters the diseased lobe. At the apex of her left lung however there is at times fine crepitation, which I think is not new but was overlooked at first. The progress of her disease seems to be arrested.

Case XX.—M. O., twenty-six years old, a watchmaker, entered the hospital April 30th, 1896. He had been a healthy boy and his parents, brothers and sisters are healthy now.

Five years ago he had an attack of hæmoptysis, a severe cough followed, but disappeared. Three years ago an enlarged cervical gland was noticed, and now his neck is deformed with greatly enlarged glands. Just below the chin and also below the right ear are discharging abscesses, recently opened in the Massachusetts General Hospital. He has weighed 136 lbs., present weight is 114½ lbs. Appetite fickle. Sleeps well. Can take long walks without fatigue. Daily fever moderate. Cough not troublesome. Bacilli tub. in sputa. In his right lung respiration was much diminished, and both coarse and fine moist râles were to be heard from apex to base.

Antiphthisin was begun May 4th in doses of 0.5 c.c. On May 16th the dose was doubled, 5.24 c.c. having been given during the month. His improvement is already noticeable. The glands have diminished, his weight has increased 2½ lbs. and his right lung is clearer at the base. His chest inflation has increased from 1½ to 3¼ inches.

Case XXI.—Miss M. L., twenty years old, entered as an out-patient Dec. 4, 1895. Parents living. One sister died of phthisis four years before. Three years ago she was all run down and had a severe bronchitis. Has coughed ever since, and more for the past six months. Menstruation never regular. Is now only three pounds short of best weight. Works in the watch factory.

Right upper lobe dull; increased vocal fremitus, subcrepitant râles. Bacilli tub. in sputa. Slight daily fever. From December 13th to January 6th 1 c.c. of antiphthisin was given except for two intermissions of six days each until March 4th, when she left for Colorado.

Several times during this time she caught cold and each time lost the few pounds she had meanwhile gained. But her lung on the whole improved. The plentiful fine moist râles gave place to occasional dry explosive râles. More air entered. Her chest inflation increased from 2¼ inches to 3¾ inches. She has since lost ground in Colorado.

Case XXII.—Miss W. M., had worked in the watch factory for several years before entering the hospital Feb. 17th, 1896. There has been much phthisis in her family. Three years ago she had pneumonia, and one year ago bronchitis. Has been coughing ever since, especially at night. Expectoration free and full of bacilli tub. Very feeble, almost no appetite, high fever in the afternoon. Very thin and anæmic. Both lungs diseased, hardly a clear spot to be found in either.

The antiphthisin treatment was begun March 1st in doses of 0.5 c.c. and increased to 2 c.c. by March 26th. Up to June 1st 89 c.c. were given.

For a few weeks her life seemed near its close, but to the surprise of every one, she rallied. Her fever subsided, her appetite and strength returned, the cough diminished, her weight increased by nine pounds.

On May 14th she was transferred to the out-patient department, and she has since continued to gain in every way.

There are well marked cavities in each upper lung, more marked than at first, as is often the case in the convalescence of tuberculous lungs. But more air enters, the râles have greatly diminished, and she feels well again, being able to walk several miles each day without fatigue.

Her daily charts for her first and tenth weeks under treatment show even more plainly than her summary chart how great was her gain. And these daily charts also serve to explain the method, previously described in this paper, of estimating for the summary chart the amount of the daily fever. (See Chart XXII.)

Case XXIII.—Mrs. S., 32 years old, entered the hospital Feb. 28, 1896. Family history negative. She has four children, and had been perfectly well till December, 1895, when she caught cold. She was then much run down, because of her baby's long sickness. In January her cough increased, and for several weeks she was confined to her bed.

Her weight on entering was 105½ pounds. She had a moderate daily fever.

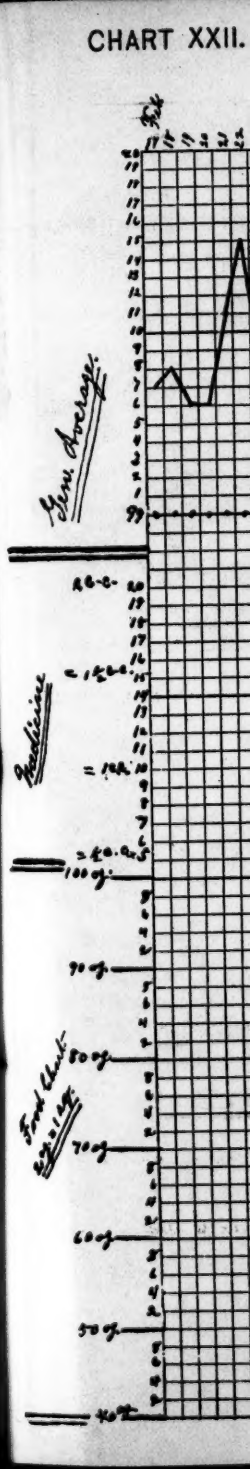
There were rough friction sounds in the upper right and absolute flatness with bronchophony and coarse râles in the lower right chest. In the left nipple region were fine and medium moist râles.

She remained in the hospital sixty-three days, during which she gained 7½ pounds. 50 c.c. antiphthisin were given her, in doses from 0.5 to 1.5 c.c.

Her appetite and general health improved. The fever, which was very variable, lessened. The left lung became entirely clear. The upper right improved, but the flatness in the lower right remained.

During the month following her return to her home she had more fever and lost some in weight.

Case XXIV.—W. Z. R., a farmer, 31 years old, was treated as an out-patient of the hospital from Nov. 22, 1895, to Feb. 6, 1896. A brother living with him had died of consumption in 1894. In March, 1895, he had severe pleurisy followed by a heavy "cold on the lungs." In August he had malaria, after which his cough was worse.



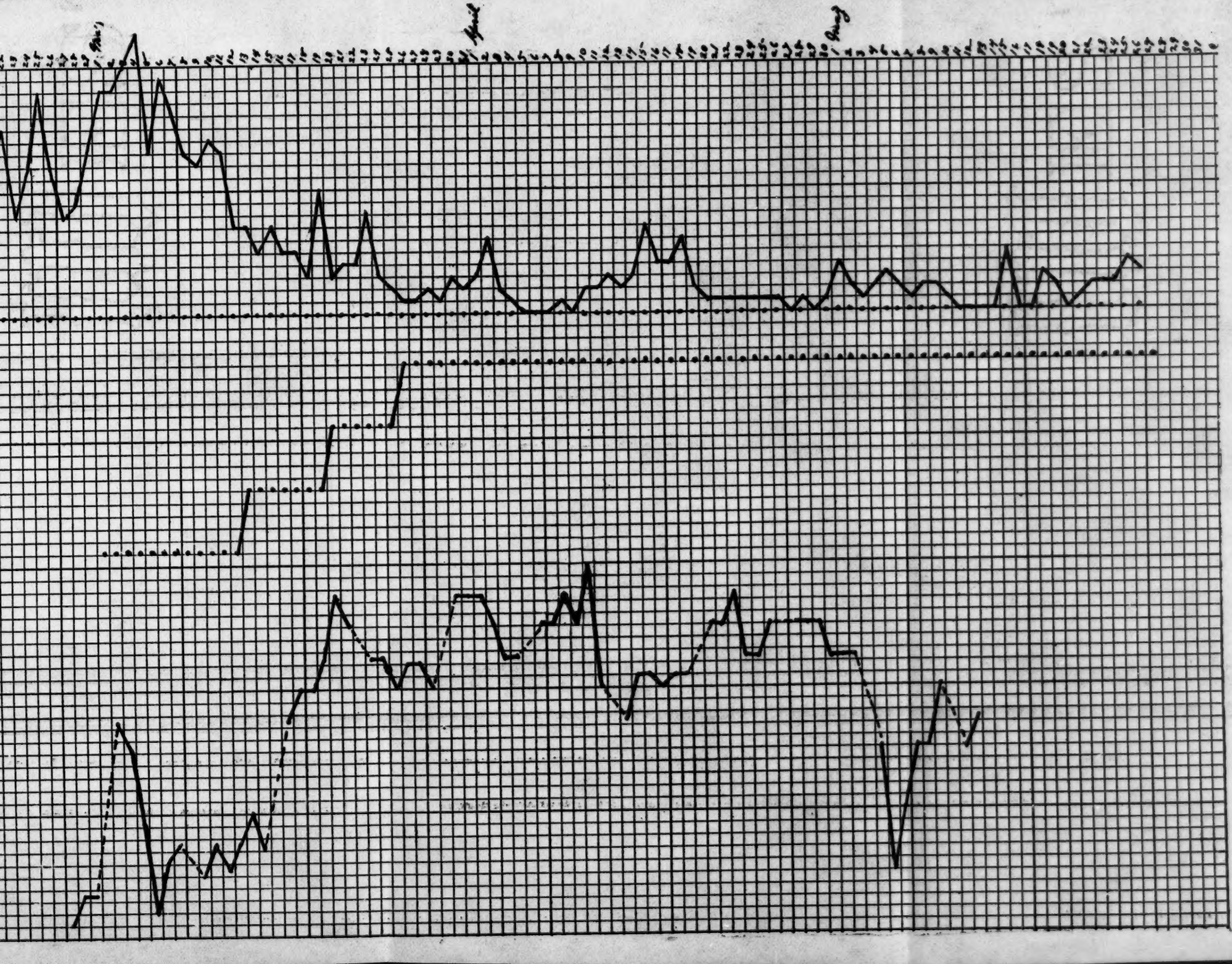
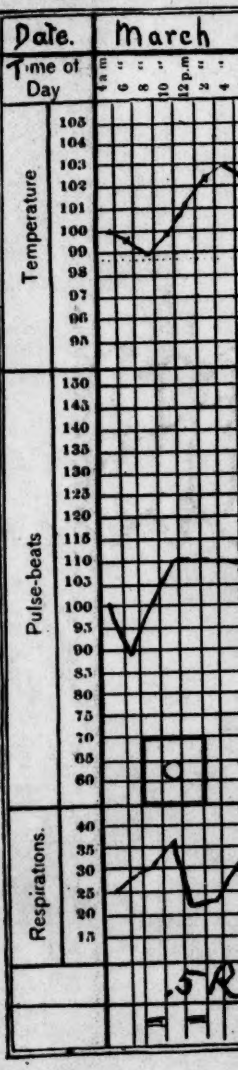


CHART XXII.


Date.
March
Time of Day
Temperature
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102
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100
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Pulse-beats
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120
115
110
105
100
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Respirations.
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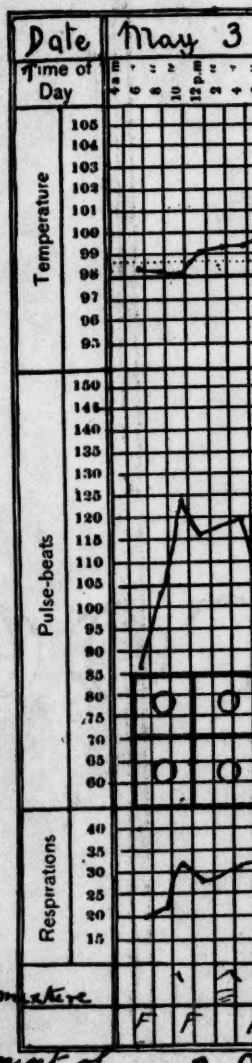
RT XXII. First week of Treatment.

CHART XXII.

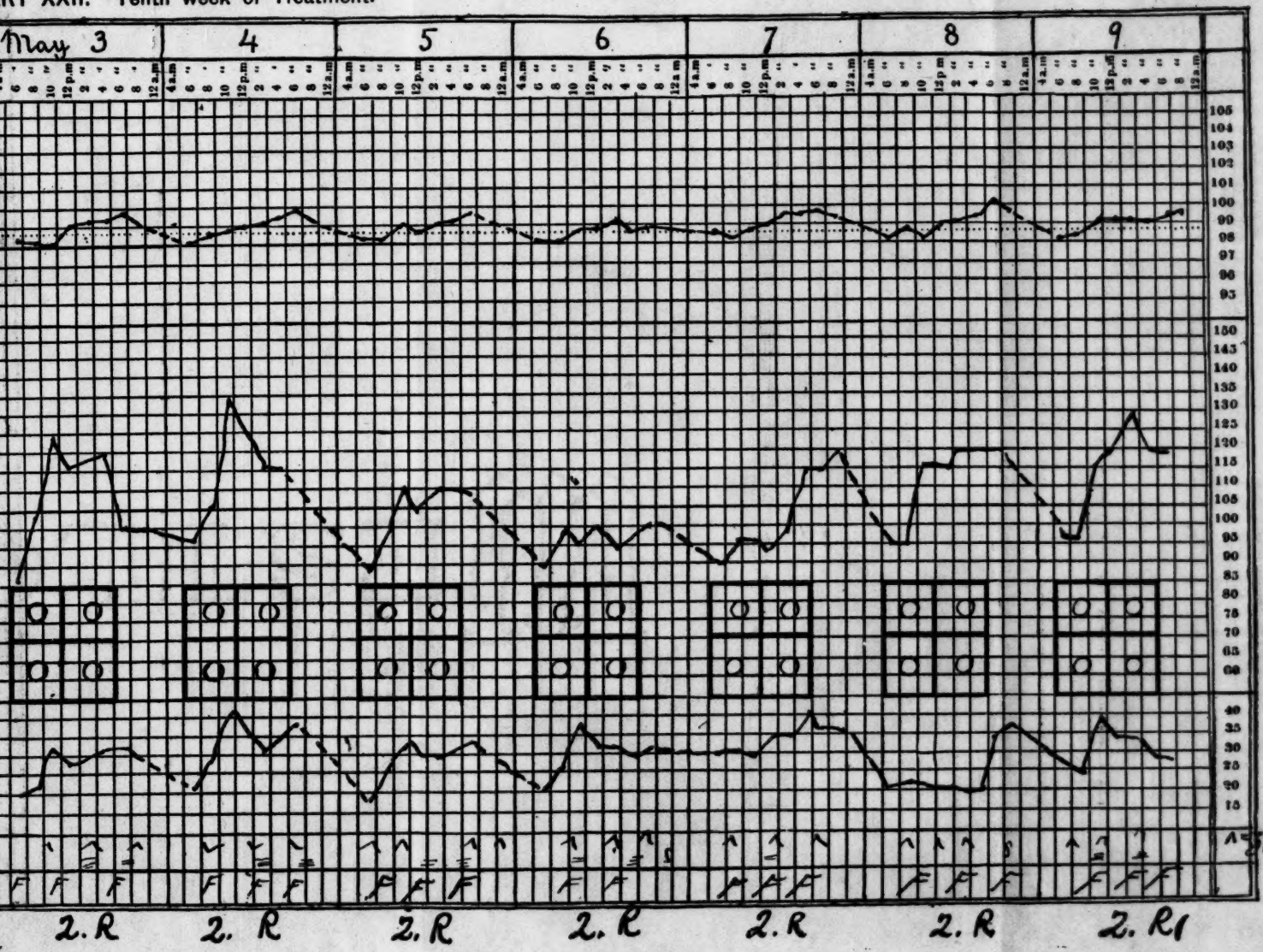


gh mixture

Amount of
ntiphlogistin

2. R

RT XXII. Tenth week of Treatment.



He had weighed 160 pounds, present weight 145, appetite poor, coughing constantly. Bacilli tub. in sputa. His upper left lobe was dull and full of medium and fine moist râles. Antiphthisin was given him in doses of 0.5 c.c. for five days, and then by daily increase of .1 c.c. up to 1 c.c., which was given for twenty-five days in succession. His improvement was very marked, in spite of an acute abscess in the left middle ear, which caused high fever and interrupted the treatment for several days. During the followlowing month the antiphthisin was given in larger doses, 3 c.c. having been given two days in succession, with steady lessening of the fever. 90 c.c. in all were given him. He gained 8½ pounds. His chest inflation increased from 3½ to 4½ inches. The râles diminished. Although doing well, he was advised to take advantage of an opportunity to remove to North Carolina, where his improvement is reported to have continued.

Case XXV.—Miss B. G., 17 years old, entered the hospital August 26, 1895. Her mother died of phthisis a year before. When four years old, she had a long siege of suppurating glands in the neck. Never a strong girl. Menstruation irregular, none since February. Has coughed for several months. Has lost 12 pounds since January, although appetite has always been good. Complexion poor, of dusky bluish tinge. Left upper lung dull to percussion, full of fine moist râles. Many bacilli tub. in sputa. Daily fever, which was increased by injections of .001 c.c. of tuberculin.

On September 9th antiphthisin was begun in doses of 0.1 c.c. For a few days the fever was apparently increased, and so again ten days afterwards when the dose was gradually being increased to 0.5 c.c. But when, after a few days of intermission or of smaller doses, 0.5 c.c. was again given, there was not nearly so much reaction; and a month afterwards, when the dose was increased to 1 c.c., there was hardly any febrile reaction. The same treatment was continued till January 4th. When she was transferred to the out-patient department November 13th, her cough had practically ceased. No bacilli tub. could be found in her expectoration. She weighed more than ever before, having gained 17½ lbs. Her fever disappeared entirely.

During the early winter she was very well, walking several miles a day or skating for several hours without fatigue. By midwinter she began to complain of pain in her "stomach." She caught cold and began to cough.

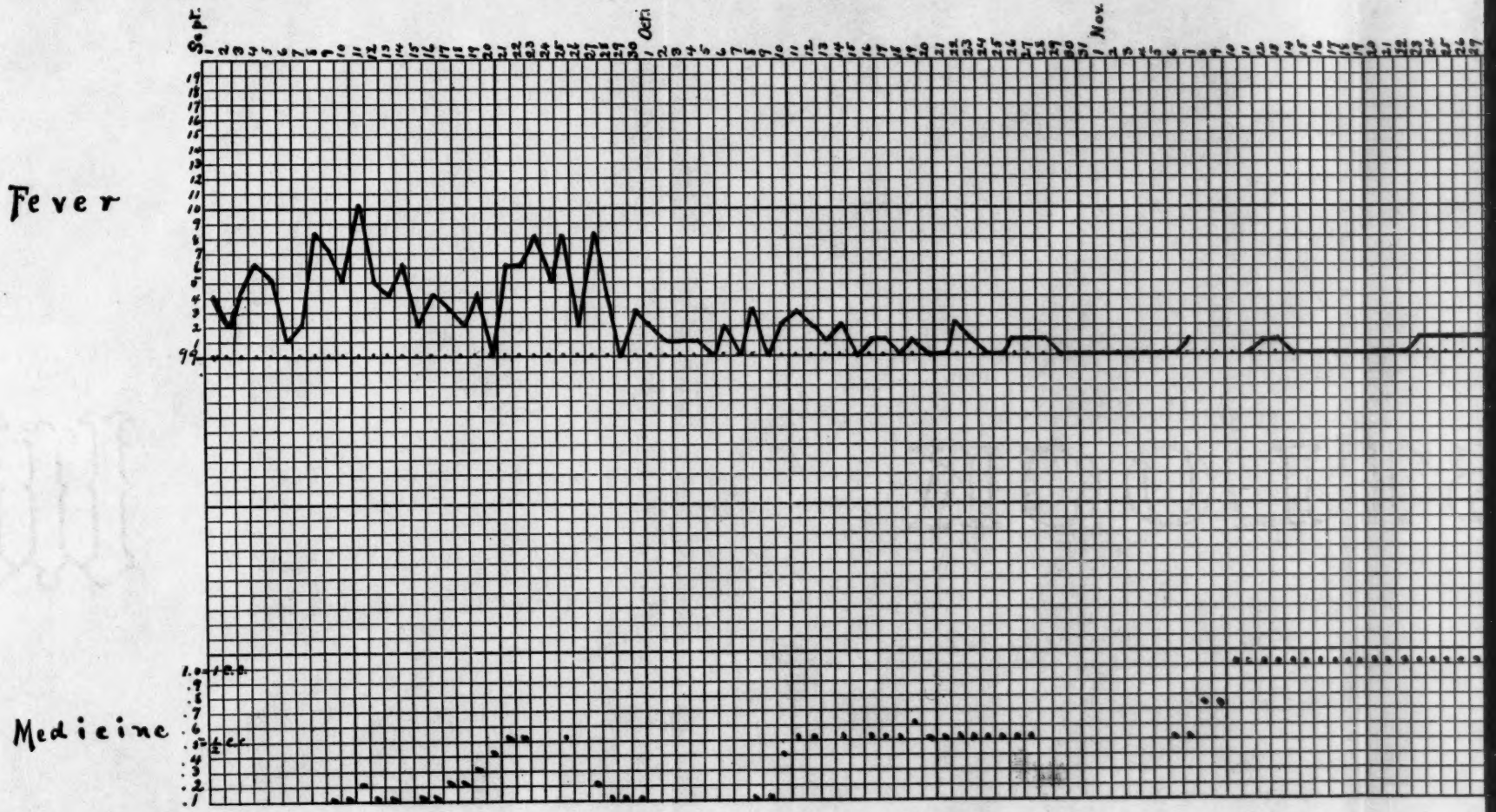
Her home was ten miles away and her infrequent visits to the hospital and lack of careful records prevented such oversight as was desirable. Occasionally she was given 1. c.c. doses of antiphthisin which she persisted produced fever. Her weight fell off four pounds. Examinations of her chest revealed no cause for her increasing debility, which was therefore ascribed to dyspepsia. On May 1, 1896, she was re-admitted to the hospital and then the cause of the "stomach-ache" was soon apparent. The abdomen was tender and somewhat rigid. In the right iliac fossa was a tumor the size of an orange, exquisitely tender at McBurney's point. This had probably developed only within the past few days. Surgical interference naturally followed. A few ounces of foul pus escaped from an abscess cavity the walls of which were made up of thickened omentum and mesentery. The appendix was not found, but bluish semi-translucent glands the size of a pigeon's egg were found in abundance. Some of them were dug out. Her father on seeing some of them said he had shortly before killed a cow, fat and healthy apparently, but full of the same kind of glands.

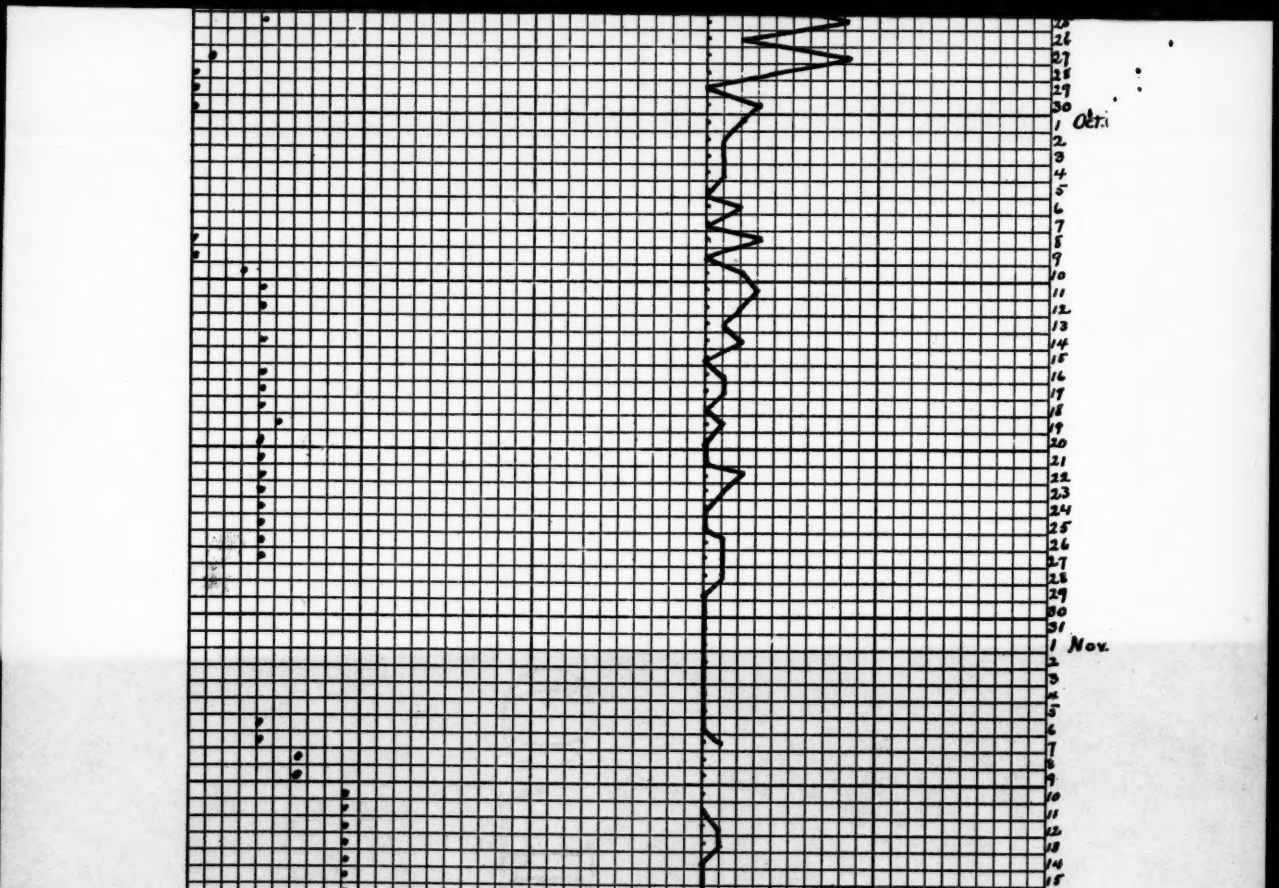
She rallied well from the operation but has since been kept flat, the wound healing only slowly and the fever being constant. There has been no coughing since the operation but she seems to be steadily losing ground. (See Chart XXV.)

Case XXVI.—T. A. E., a student 17 years old, came to the hospital, May 10, 1895. For two months previously he had been taking antiphthisin under the care of Dr. J. T. G. Nichols, with whom I had the pleasure of serving in consultation.

The family history is negative. During the summer of 1895 he worked hard, and was in consequence somewhat run down. In December he began to cough. In January he was found to have a slight daily fever, there were râles in the left apex, and bacilli tub. in the sputa.

CHART XXV.




26
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1 Oct.
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The disease was evidently making progress when the antiphthisin treatment was begun, March 5th, in doses of 0.5 c.c. By successive increments of 0.5 c.c. the dose was increased to 2 c.c. by April 9th. As the daily fever grew worse the dose of antiphthisin was reduced to 1 c.c. for the first two weeks of May, and during April and May it was often given only every other day or with occasional intervals of two days. No connection favorable or unfavorable could be discovered between the administration of the antiphthisin and the daily fever. On May 10th he was moved to the hospital. His left lung has progressively degenerated. In April there seemed to be trouble at the right apex, but this has since disappeared. He does not seem as sick as his high daily fever would seem to warrant. The most that can be said is that while no apparent effect has followed the use of antiphthisin yet he does not seem to go down hill as rapidly as our former experience would lead us to expect.

ARTICLE VI.

EXTRA-UTERINE PREGNANCY

FROM THE STANDPOINT OF THE GENERAL PRACTITIONER.

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EXTRA-UTERINE PREGNANCY
FROM THE STANDPOINT OF THE GENERAL PRACTITIONER.

In considering this important subject, we want to dwell as briefly as possible on the interesting but dispensable facts of embryology, morphology and pathology.

Systematic writers have so enshrouded the subject with needless and clinically impossible refinements of classification, that the student is prone to give up in dismay.

The frequency, etiology, diagnosis and treatment will concern us most, and these considerations no general practitioner can afford to shirk.

Our treatment of the subject will have most to do with cases after rupture.

When we who graduated fifteen or twenty years ago were on the benches, our teachers, or rather lecturers, generally the gynecologists, talked some of hematocele, but the professor of obstetrics usually fought shy of extra-uterine pregnancy altogether.

Our text-books did little more than give us awful hints of these cases, when diagnosis was more than doubtful and the anomaly almost always fatal; and so we were left, blind as Ajax — but without his strength to meet the dread encounter which must come.

Intra-peritoneal hematocele was dwelt on as an entirety which might be due to extra-uterine pregnancy, but some authorities hardly admitted even this. (Skene in 1888.)

When we refer to our text-books up to ten years ago, and note the contained teachings and recorded results, and

compare these with later experience recorded in current literature, we are struck with the ephemeral value of our cherished volumes. We are also forcibly impressed with the fact that our thanks for later progress are due to the gynecologists rather than to the obstetricians. But this is less to the discredit of the latter than at first seems manifest, for the former have literally the inside track, and have improved their opportunities.

It is trite to say that abdominal surgery has made far-reaching advances in the past decade, but some of us may fail to connect this advance with our subject. Great lessons are slowly learned by the average mind, especially when they run counter to conservative instincts and prejudices.

If anything we can report now, or elicit later on in your discussion, shall help a brother to a clearer, quicker diagnosis of this anomaly—or nerve the usually far from languid arm of a gynecologist, to a prompt, though desperate laparotomy, we know that oft-times the trebly valuable life of woman, wife and mother can be saved thereby.

Does some one say I have practised twenty years and never seen a case? We see only what we have learned to recognize, and when we really acquire some new truth we marvel at the apparently wonderful duplication of occurrences involving it.

It is the unexpected that happens, and your next case may be one of extra-uterine pregnancy.

Some have said the same of appendicitis, but who doubts that we formerly overlooked it?

There is a curious parallelism here between the medical history of appendicitis and that of extra-uterine pregnancy. Peritonitis for years masked appendicitis, as inter-peritoneal hematocele hid *its* cause, extra-uterine pregnancy, in its own clots.

Peritonitis, like charity, covers a multitude of (diagnostic) sins. One is tempted to digress here and inveigh

against our honored Boards of Health, who refuse to let us record "heart failure" as a cause of death, but accept unquestioned our ignorance or blunders if we say peritonitis.

FREQUENCY.

I can find no available statistics on the number of extra-uterine pregnancies. I asked the Boston Board of Health for the number of fatal cases during the past year, and was told that there were no deaths so classified, and that it would take too much clerical work to find out. Personally I know of two fatal cases in South Boston, during the time covered by my paper. Allow me to give my own figures. For five years, from June 1st, 1891, to June 1st, 1896, I have cared for about 850 pregnancies, and seen them terminate in abortion, premature or term delivery. During these five years I have met in my own practice five cases of extra-uterine pregnancy. All five cases ruptured before a diagnosis was made, were operated upon, made good recoveries, and are still under observation.

It does not seem possible that one pregnancy in every 175 is ectopic, as these figure show. Five cases in 850 pregnancies are too few to be conclusive, but it must be admitted that they are very suggestive and cannot be satisfactorily explained as mere coincidences. It is very probable that such cases often pass unrecognized when fatal, or are stumbled on at autopsies, or at operations, for some other assigned disease.

ETIOLOGY.

If we recall the physiology of conception, it is on the theory that the spermatozoa must reach the ovary *via* the Fallopian tubes before the female primary element is fertilized. The spermatozoa have to accomplish this journey by their inherent wriggling or sculling motion, and against the current of the ciliated epithelia lining the Fallopian tubes.

The vitalizing contact having been accomplished on, near, or *in* the ovary, the ovum is believed to reach the cavity of the uterus by the motion of the ciliated epithelium above mentioned, aided by some vermicular motion of the tube itself. Now from inflammatory changes in the tube causing stricture, obstruction from tumor pressure, diminution of its lining epithelium, or any pathological cause leading to partial obliteration of its lumen or change in its lining, the now greatly enlarged ovum lacking inherent motion, may get *side-tracked* somewhere on the surface of the ovary, in the peritoneal cavity, or as oftenest happens in the free part of the tube. When we consider the process, the wonder is that it does not occur more frequently. We believe that it may happen even where the pelvic viscera are in a perfectly normal state. Veterinary surgeons tell us that it is common in cows under the name, when calcification has taken place, of stone calves, and I have seen it in the field rabbit (hare.)

Whether arrested in the ovary, in contact with the peritoneum in its vicinity, or in the fimbria or lumen of the tube, its inherent vitality is such that attachment and growth *must* go on. The one condition of this growth and development is enormous vascularity. An encasing capsule of vessels develops around the ovum from whatever the contiguous structure, and for a while the ovum grows.

But the vascular capsule is frail and lacking the firm backing of the womb, unless in the intermural portion of the tube it is very prone to rupture in the early months.

Any condition that may determine an abortion in normal pregnancy acts with much greater certainty here, and few cases comparatively go to or beyond the time of placental formation. If the fetus develops in that part of the tube that traverses the uterine wall, it is not improbable that gradual dilatation of the tube may finally merge its lumen with the general cavity of the uterus, and full development

and normal delivery be accomplished. In one of my cases the sac was close to the uterine wall, but no such happy termination occurred.

PATHOLOGY.

On rupturing, the pain is terribly intense, and a surprising hemorrhage with the development of shock occurs.

The sudden and unaccountable transition from assumed health and comparative comfort to a state of intense suffering, helplessness and fear, adds an element of terror to the prostrated patient which may amount to delirium or partial stupor.

There are abdominal distress, faintness, nausea, vomiting and rectal tenesmus. After the inter-vascular pressure is reduced by this depletion and the heart weakened in consequence, the hemorrhage may cease spontaneously, to begin again after rallying, if the latter occurs. The effused blood may clot with such firmness over one or the other tube as to give a visible projection in the corresponding quadrant of the abdomen easily palpable by the fingers, to which it gives a doughy resistance. This was manifested in one of my cases, when some time elapsed between rupture and operation.

If the hemorrhage does not recur, there is still the risk of septic infection and fatal peritonitis, or the safer though slow and exhausting process of incapsulation, and later ulceration into some neighboring viscera or through the abdominal wall.

That nature can and does rescue some of these cases is certain; but to hope that she will, even in a fair minority of the cases, is to expose our patients to a needless risk.

Obstetric authorities are agreed upon the high mortality rate of these cases of extra-uterine pregnancy after rupture, and twenty years ago Meadows spoke prophetically of the value of laparotomy for the same.

DIAGNOSIS.

When we are urgently called to the bedside of a woman suffering from a ruptured extra-uterine pregnancy her awe-struck face will usually tell the story more eloquently than her feeble words.

The pinched and ashen features are beaded with sweat; the nose and ears are cold; the pupils dilated, and the lips are almost as pallid as her cheeks. The hair may be dripping as if it had been submerged. The breathing is shallow and the voice feeble. By choice, she lies quietly on her back in the bed, for motion gives pain. The pulse is small and hardly obtainable, and will vary from 100 to 140. As might be expected, the temperature in the period of collapse is sub-normal, 97°, but after reaction, if it recurs, the temperature may reach 99° or 100°.

No practitioner who has seen a stab or a gun-shot wound of the abdomen, with hemorrhage, or a case of perforation of the bowel in typhoid fever, can fail to be struck with the similarity of appearances presented by a woman with a ruptured extra-uterine pregnancy, except that as the hemorrhage is greater the manifestations are more striking. I am convinced that the diagnostic value of the facial expression cannot be overestimated.

Now, given a patient with the appearance I have tried to portray, and getting a history of eight or ten weeks of menstrual irregularity in a married woman, these conditions ought, at least, to put us on our guard. Better far to err on the side of assumed gravity than to lull one's self and the patient into the fatal blunder of optimistic expectancy. To fix the value of the patient's appearance, let me give a personal experience. For some time, when younger, I had dreaded to meet extra-uterine pregnancy.

On one occasion, when called to a severe case of intestinal colic (probably ptomain poisoning) with a history of missed

periods, I was impressed with the belief that I had at last found what I had long dreaded to meet. I did not note that the characteristic aspect of peritoneal invasion was absent. I summoned a specialist (at my own expense) who examined her, and he, having no preconceived opinion, decided against me. Shortly afterward the patient vomited a large quantity of chocolate pie and ham, and my case of ectopic pregnancy vanished, leaving *me* very sore. Six months afterward, however, a real case of extra-uterine pregnancy presented itself, the patient bearing the evidence on her countenance of the awful plight she was in. So striking was the sight, that though still suffering in mind, body and estate from my former "faux pas," I *knew* that I had to deal with an inter-peritoneal hemorrhage, and within three hours had the satisfaction of having my former consultant verify my diagnosis by a successful laparotomy, on this the first of my five cases of ectopic pregnancy.

To return to other diagnostic features: — When the abdomen is exposed we are struck by its pallor, coldness, and, if the rupture is recent, by its *lack* of distention. Later on, distention may be found, especially if septic infection of the effused blood has occurred. There will be found a sensitive area over one ovarian region, and palpation here may meet with a doughy, muffled sensation on deep pressure. Percussion over an area of varying extent, will give a note ranging from intestinal resonance at the margins of the area to flatness in its centre. If the blood is still fluid it will gravitate to the lowest flank to some extent, when the patient lies on that side.

Digital examination by the vagina after rupture has not been of much help in my experience, except in excluding uterine pregnancy. During the progress of an extra-uterine pregnancy there is not usually a total suspension of the menstrual discharge, and this fact misleads the patient who may have the subjective signs of pregnancy and still believe that she is menstruating.

In ectopic gestation as in normal pregnancy the endometrium develops a decidua, but disappointed at the non-arrival of the ovum, it is shed in dark semi-fluid shreds that confuse the patient. This symptom occurred in nearly, if not all of my cases, and has some diagnostic value.

Given a patient, then, who is living in the marriage relation, and who is in the period of mentrual activity, who presents the clinical symptoms mentioned above, can a diagnosis of extra-uterine pregnancy be made before three months, unless rupture has taken place? We certainly see much the same train of symptoms in some who go the full time, and in some who abort early. Two of my cases were under observation for days before rupture, and I did not suspect ectopic pregnancy, nor was there any urgency in their condition. I doubt if an expert would have made a diagnosis with enough certainty to justify operative interference.

After rupture has taken place, however, I hold that the average practitioner ought to make a prompt and positive diagnosis, and he must have courage of his convictions to insist upon radical measures. In no other way can he overcome the doubt and inertia with which his opinion may be met by the patient and her friends, when doubt and delay mean danger or death. After the urgent pain is relieved by morphine, as it should be, she will want to temporize.

TREATMENT.

When you reach a patient after rupture of an extra-uterine pregnancy, the pain and collapse call for a full dose of morphine, $\frac{1}{4}$ to $\frac{1}{3}$ grain with 1-100 grain of atropine subcutaneously, and this may have to be repeated. The relief and apparent improvement induced thereby are surprising, and though necessary, may obstruct your efforts for your patient by making her unwilling for the radical but imperative laparotomy. Heat applied externally, and the hori-

zontal position will help to equalize the feeble circulation. Some authorities advise *ice* over the abdomen to check the hemorrhage. Probably if you depend on this, the undertaker will continue its use.

The real treatment must be prompt and can be summarized in the old surgical axiom, Cut down and tie the bleeding vessels. Remove the sac, clean out the effused blood, and if possible close the abdominal wound without drainage. Why hesitate to operate? All agree as to the terrible fatality, if left to nature, of these cases after rupture and hemorrhage. You are going to operate upon an aseptic inter-abdominal wound, where you know that no vital organ is injured; where there is no antecedent disease to militate against success, and no adhesions to threaten secondary hemorrhage or intestinal obstruction later. There is no inflammation, impaired vitality from pressure, dyscrasia or senile changes to offer trouble to the operator now, or later make life a burden for the family physician, as is apt to be the case after so many elective laparotomies. Here it really seems as if there could be no alternative. Let me emphasize. Don't let the corpse-like appearance of peritonism make you withhold from the pallid creature her one chance of life. Here, as in happier circumstances, "Faint heart ne'er won fair lady." Several times when I was giving ether in two of my cases, the pulse has almost disappeared, but rallied again under full doses of strychnia hypodermically. In another case the rigid exactness of the peritoneal toilet had to be omitted, so low was the patient, and still both cases made full recoveries. If, therefore, you are far from expert help, don't hesitate to do the best you can, using aseptic precautions. The gynecologists say that it is not a difficult operation in itself, and bi-chloride and boiling water are everywhere obtainable.

Although I have never performed a laparotomy, I should not hesitate to attempt it, if I met one of these cases so re-

mote as to require many hours to get greater skill. Our fathers were expected to be equal to strangulated hernia or to an amputation above the knee, and with the better training of to-day no practitioner ought to shirk the relatively no greater responsibility of an emergency laparotomy for an ectopic gestation after rupture. Fortunately, however, there are few communities now where special skill cannot be obtained. Let the general practioner make the diagnosis, and no operator will hesitate. If within reach of a hospital, by all means get the patient into it. One of my cases was carried in the horizontal position, in a hack, three miles, without much suffering and no apparent injury.

Of the technique of the operation it is not my place to speak. Hardly less important is the after care for the first two or three days succeeding the operation. Sterilized salt solution, one drachm to one pint, and strychnia subcutaneously, have given remarkably good results in the state of peritoneal collapse, in my cases, before, during and after operation.

RESULTS.

After operation for extra-uterine pregnancy, convalescence is usually very rapid and complete. The antecedent conditions having been so little different from normal, the troublesome sequelæ that so try the family physician are usually missing. The patient bears children with no greater risk than before the laparotomy. Intestinal obstruction from adhesions or internal hernias are practically unknown. The general feeling of well-being, and full capacity for the usual occupation, come sooner here than can be expected where gradual structural changes have preceded operation.

Case I.—Operated on at St. Elizabeth's Hospital Oct. 17, 1892. Married. Age 38. Has had three living children and miscarried once with twins.

Menses regular but excessive. When her third living baby was four months old, and while still nursing, her menstruation was excessive and recurred every five weeks until October, when it failed to appear, and four days after it was due severe pelvic pain set in with a slight show Oct. 10th. This severe pain recurred with faintness Oct. 12th and the evening of the 16th.

On the 17th, when I was called, I found her in bed with pinched, pallid features; cold extremities, rapid, weakened pulse and some dulness in the lower abdomen on the left side. Morphia with atropia was given freely as the pain and prostration were intense, and external heat was applied.

The family physician met me as soon as he could be reached and while agreeing with me, was unable to care for her. Dr. Frederick W. Johnson was then summoned, confirmed the diagnosis and secured the patient's admission to St. Elizabeth's Hospital. She was taken there immediately, a distance of about three miles, and operated upon without delay.

The abdomen contained a large amount of clotted and some fluid blood, and an unruptured amniotic sac as large as a filbert containing an embryo the size of a honey bee. She rallied slowly but completely, and went to her home in twenty days. She is at the present time in perfect health, works hard and has a child two years old, which was born about two years and a half after her operation.

Dr. Whitney's report, Case I.—"The specimen consisted of about six or seven centimetres of the Fallopian tube with the ovary attached, and an embryo about three centimetres long in an unbroken sac filled with clear fluid. About two centimetres from the fimbriated end the tube was dilated into an egg-shaped enlargement about three centimetres in its longest diameter. The free surface was torn and from this a shaggy tissue, infiltrated with blood, projected. Microscopic examination showed this to be made up of branching fibrous filaments. The ovary, to which the end of the tube was slightly adherent, contained a large corpus luteum."

Case II.—Operated upon at Carney Hospital, Oct. 4, 1894. Married. Age 26. Had one child. Nursed her baby twenty-two months and did not menstruate. Always had dysmenorrhea. After weaning her baby resumed menses for four months, but in Sept. 1894, missed her period, but suffered pelvic pain which was continuous until her operation; was treated for this pain, but with little result. On Oct. 4th at 6.30 P. M. she was seized with such severe pain in the lower abdomen that she seemed as if in labor. The extremities became cold, the face pallid and beaded with sweat, pulse 120 and temperature subnormal. I was called at 7 P. M. and found her condition so alarming that I immediately telephoned to Dr. Frederick W. Johnson, with a view to an operation if he agreed with my diagnosis. Meanwhile, morphia and atropia were given subcutaneously and external heat applied. Pain was thus relieved but no other improvement was effected. The abdomen was tender to pressure and uniform dulness extended over the whole of the left side.

Upon Dr. Johnson's arrival it was decided to remove her at once to the Carney Hospital, where she was operated upon at 9 o'clock P. M. Her pulse at that time was 140 and it was necessary to administer strychnia and brandy at intervals. So exsanguined was she, that no bleeding occurred when making the abdominal incision. The peritoneal cavity was found to contain more than a quart of blood, both clotted and fluid. The blood was found to have come from an extra uterine pregnancy on the right side. (See Dr. Whitney's appended report).

Transfusion was done after a very hasty operation, and despite her desperate condition she made a good recovery, leaving the hospital at the end of twenty days. She is at the present time pregnant and almost at term, being in excellent health and able to perform her housewifely duties.

Dr. Whitney's report, Case II.—"The specimen removed by you October 4th consisted of a portion of the tube and an ovary. About one inch from the fimbriated end was a dark-red, nodular swelling covered with clotted blood; this measured about one and one-half inches in diameter. On section there was found in the centre a cavity about half an inch long lined with a smooth membrane, and in which

was the remains of a small embryo. In the ovary was a corpus luteum about three-quarters of an inch in diameter."

Case III. — Operated upon at the Carney Hospital, March 19, 1895. Married. Age 33 years. Has had four living children and one miscarriage. Enjoyed good health except that at her miscarriage the placenta was retained giving rise to a severe and protracted flowing with sepsis. After that, however, she had borne one healthy child at full term, though she had a severe post partum hemorrhage. She had fully recovered when conception took place. For two periods she did not menstruate, but instead observed the decidual shedding with more or less blood. Had no nausea, but supposed herself to be pregnant.

I saw her — not professionally — two or three days before rupture occurred, but she was not ill enough to consult me at that time. On the 19th of March, while preparing her husband's dinner, she was interrupted by a call from a neighbor. Leaning back against a table, she suddenly felt the rupture accompanied with acute pain and faintness. She was assisted to a sofa, and her husband at once started for my office, but met me on the street, and thus I reached the patient in less than half an hour after her seizure. Already her face was blanched with the characteristic pallor and beaded with sweat. She was so weak as to be hardly able to speak. A rapid examination satisfied me of the nature and gravity of the trouble, and after giving morphia and atropia subcutaneously and applying external heat, I informed the husband of my suspicions and urged counsel and an operation.

Learning that Dr. Rufus A. Kingman was at the Carney Hospital I immediately summoned him. In accordance with his advice she was at once carried to the Carney Hospital in a hack. So low had she became by this time that she took no interest in the arrangements in her behalf, and twice during the operation we expected her death as the pulse became imperceptible. On opening the abdomen a large amount of fluid blood was found and a ruptured tube. Owing to her extremely reduced condition, the peritoneal toilet was hurried and incomplete, and she was put to bed, and external heat applied. Stimulants were given by the rectum, and full doses of strychnia and normal salt solution

were injected to give the heart something to work on, and help it do it.

Her convalesence was slow, but her recovery at the expiration of seven weeks was complete, and she is to-day well, and able to enjoy life and perform her usual duties.

Case IV.— Operated upon at Carney Hospital October 8, 1895. Married. Age 40 years. Has had two children at term. Has had seven miscarriages at from four to six months. Menses normal. Very nervous temperament. Says that she has had peritonitis (probably pelvic) four times. This case was the only one in the five where a positive diagnosis of rupture of an extra-uterine pregnancy could not be made. There were some circumstances which effectually masked it, and although there was a sudden and severe exacerbation of pain, the hemorrhage though large was gradual, and the striking features of peritoneal collapse were missing. Conception must have taken place about August 12th. There was menstrual irregularity, but no absolute suspension of the function, and there were vague pelvic pains preceding the rupture which occurred at stool. Dr. Rufus Kingman saw her twice in consultation, and narrowed down the diagnosis to one of two things, one of which was extra-uterine pregnancy.

She was admitted to the Carney Hospital, and operated upon October 8th by Dr. Kingman. This was the case previously referred to in my paper, where the blood clotted so firmly and so locally that a visible tumor was outlined in the lower left quadrant of the abdomen, otherwise the case presented nothing of note and made a good though slow recovery.

The ruptured tube was found, but the embryo was lost in the blood clot. The specimen removed consisted of the left ovary and the distal part of the corresponding tube which had ruptured. It was examined by Dr. Whitney, but his report has been misplaced. As the other ovary was found to be in a bad condition it was, agreeably to her previously expressed wish, removed also.

Case V. — Operated upon at Carney Hospital March 2, 1896. Married. Aged 30 years. General health always good. Menses painless but abundant and prolonged.

For some weeks before rupture she was under treatment at a dispensary for some pelvic trouble. Monday evening, March 2d, she spent playing checkers with her husband, and was in her usual health. About nine P.M., before retiring, she took an enema to act on the bowels. Severe pain began in the abdomen, which by midnight had become very acute. At one o'clock she believes she began to faint, and being alone, her husband being asleep, she lay on the floor for some time until found there by her husband who came for me shortly before 4 A.M.

So inadequate was his description of his wife's condition that I came near dismissing him with some soda mint tablets. It was a very stormy night with deeply-drifted snow, and though reluctant I went with him literally "coolly" enough. My nonchalance vanished, however, the minute I saw her. To say that she both looked and felt corpse-like hardly overstates it.

Though still suffering from intense tearing pains, her blunted feelings made her less complaining. At times she talked deliriously. Her pulse was 138, and at times could not be counted. Her pupils were dilated and irresponsive to light. Her face, hands, arms, feet and legs were cold. Temperature under the tongue was 97°, respiration shallow. Slowly I got a history of pain earlier in the night with vomiting and rectal tenesmus. The left lower abdomen gave evidence of effused blood. Vaginal examination was negative. I gave her subcutaneously $\frac{1}{3}$ grain of morphia with $\frac{1}{50}$ grain of atropia and applied heat externally. She began to get easier, and at the same time unwilling to entertain the idea of the operation which I urged.

Getting a hack before daylight, telephoning to Dr. Frederick W. Johnson to meet us at the Carney hospital, and arrange for our reception, was not quite so hard as was the task of convincing the patient and her husband of the urgency of the operation, but his failure to grasp the situation was fortunately offset by his unquestioning acceptance of what I said, and I obtained his consent. Such circumstances justify imperiousness. The neighbors protested against taking a sick and reluctant woman out in such a storm, but we carried our point — and the *patient* to the hospital, before the latter was open.

Before taking ether, she was practically unconscious, and strychnia in full doses was given, and a quart of normal salt solution injected subcutaneously before it seemed safe to give the ether. Upon opening the abdominal cavity a large quantity of blood was found, partly clotted, and in the ruptured sac was found the unruptured clear amniotic sac containing a fœtus as large as a house fly. The tube and ovary were tied off, the clotted blood washed out, and the wound closed without drainage. Stimulants, strychnia and salt solution were given as needed, and the case proceeded to a successful termination; the patient doing remarkably well, and returning to her home in four weeks, being at the present time in excellent health, and able to do her housework.

Dr. Whitney's Report, Case V.—The specimen from Case 5, consisted of a portion of the tube and ovary. Close to the uterine end was a dilation the size of the end of the finger from which a shaggy red mass protruded.

Microscopic examination showed small flat branching tufts similar to the villi chorionic, of about the sixth to eighth week. With this was a smooth unruptured sac, containing an embryo a few millimetres in length. The ovary was of normal size, and contained a large corpus luteum with a wide yellow border.

ANALYSIS.

An analysis of these five cases, shows that only three had been conscious of any pelvic trouble. All but one had borne children. Three had had from one to six miscarriages. All but one were wives of working men, and from necessity led active, busy lives. One was in poor health. Their ages ranged from 26 to 40 years. In all there had been between conception and rupture, menstrual irregularity, that is, the individually usual quantity, quality and date were changed and the dark, shreddy, scanty, tedious discharge of decidual debris, with probably some menstrual fluid, deceived and confused the patients.

In all, the event of rupture was marked, sudden and utterly prostrating. In all the pain was excrutiating, calling

for full doses of morphine, sub-cutaneously. In all five the pregnancy developed in the tube. In four, peritoneal collapse was marked. In all, the physical signs of effused blood in the peritoneal cavity were easily made out by palpation and percussion.

I believe that, without operation, four of these cases would have died before reaction from the shock and hemorrhage. In the exceptional case, the bad general state and the large amount of effused blood would have made her recovery, without operation, doubtful and slow at best.

The time of detention in the hospital after operation, ranged from twenty to forty-two days, but three were out inside of a month.

CONCLUSION.

My experience in these five cases of extra-uterine pregnancy seems to warrant me in offering the following postulates: —

1. Extra-uterine pregnancy is more common than has generally been supposed.

2. Inter-peritoneal hematocele is almost always the result of a ruptured extra-uterine pregnancy.

3. Diagnosis of extra-uterine pregnancy in the preplacental period, before rupture, is uncertain and seldom urgent, and if a diagnosis is made, the time for operation can be selected to suit attending circumstances.

4. Diagnosis after rupture should be made by the general practitioner. It is easy and of greatest urgency in view of prompt interference.

5. Prompt laparotomy after rupture is the only safe and conservative course.*

* I regret to have to record a fatal case which clinches this postulate. Nineteen days after this paper was presented, while it was still in the printer's hands, I saw in consultation another case of ectopic gestation, which was quite typical.

At the time I saw her the rupture was fourteen hours old. Together with her family physician, I urged a prompt laparotomy. Through the

6. The condition of peritoneal collapse, *i.e.* shock and hemorrhage, is no bar to immediate and successful operation.

7. The operation of laparotomy for extra-uterine pregnancy is comparatively easy, and the mortality from it is low.

8. The after effects of the operation are milder in extra-uterine pregnancy than in laparotomies for appendicitis, pus tubes, uterine fibroma, or ovarian cystoma, and do not involve sterility.

I cannot close this paper without expressing my warmest thanks personally, and on the part of these five poor women, to Drs. F. W. Johnson and R. A. Kingman to whose promptness, liberality and skill these patients owe their lives, and also to Dr. W. F. Whitney, whose exact pathological work gives value to these reports.

patient's utter refusal to go to the hospital, however, it was forty hours after rupture before the operation could be performed. She lived about a week.

I am convinced that, had the operation been done when it was first urged, the patient would have recovered, as her condition was no worse than that of three of my cases.

ARTICLE VII.

NUCLEINS AND NUCLEO-PROTEIDS IN THEIR RELATION TO INTERNAL SECRETION.

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NUCLEINS AND NUCLEO-PROTEIDS IN THEIR RELATION TO INTERNAL SECRETION.

THE internal secretion of glands is rapidly becoming a subject of primary importance to the physiologist, and its development bids fair eventually to furnish the physician with a fund of knowledge directly applicable to the explanation of many obscure disorders, and replete with suggestions as to methods of treatment. Until quite recently the more prominent secreting glands and structures of the body have been associated solely with their obvious function of manufacturing a specific secretion or excretion to be discharged externally through special conducting tubes. The existence of so-called ductless glands, however, such as the suprarenals, thyroid, thymus, etc., with cellular structure bearing all the marks of active tissue, has long pointed to the probable manufacture in such glands of specific secretions designed solely for internal use, viz., the manufacture of substances which may be at once reabsorbed into the blood, and perhaps utilized in a variety of ways for controlling and regulating either special or general metabolism.

There is, however, no reason for limiting such a form of secretory activity to the ductless glands, for, as is quite obvious, every part of the body is the seat of some form of metabolism by which certain products result, and these in some shape may be returned to the blood, and thus distributed through the body, their physiological action being

thereby rendered available. Hence, the blood may be in continual receipt of a variety of useful substances, products of the internal secretion of various glands and tissues. Indeed, it is quite probable that some, and possibly all, secreting glands, even those endowed with the power of manufacturing such important external secretions as the pancreatic juice and the bile, are of greater value to the body because of the products constituting their internal secretions than from their ability to manufacture more obvious external secretions. The truth of this assertion has been clearly established in the case of the liver and of the pancreas, and probably also even with the kidneys. The complete removal of the liver and of the pancreas is, as is well known, followed very shortly by death, and this not as the result of the absence of the bile and the pancreatic juice, but rather from the deprivation of those internal secretions, emanating from these glands, which influence the general metabolism of the body. As Hédon and others have shown, it is quite possible to destroy the ordinary secreting cells of the pancreas, thus doing away entirely with the production of pancreatic juice, without any of those symptoms so characteristic of the entire removal of the gland. If, however, the gland is entirely removed symptoms of glycosuria at once appear, and the animal speedily dies. Further, if in extirpating the pancreas a small portion of the gland is left, this residue of glandular tissue may be sufficient to prevent the appearance of serious symptoms. Or, if a small piece of pancreas from some other animal is grafted on, either into the peritoneal cavity or even under the skin, the entire pancreas may then be removed without the appearance of glycosuria. In other words, we have in these facts pretty certain evidence that the pancreatic gland manufactures something, in small amount perhaps, which is eventually poured into the blood, and which prevents the excessive formation of sugar in the body, or enables the body to burn the sugar that may be formed.

This, then, may be taken as an illustration of the importance of internal secretion, since in this gland, which plainly has an important function in the manufacture of the pancreatic juice, there is formed something absolutely essential for the physiological equilibrium of the body; something which is thrown into the blood-current, and without which the body cannot thrive. This is unquestionably not true of all glands, at least to the same extent. Thus, in regard to the salivary glands, or more particularly the parotids and submaxillary glands of the dog, Schäfer* has very recently shown that these glands, unlike the pancreas, do not furnish any specific secretion necessary to the life of the animal or having any important action upon any of the metabolic processes. At least, the complete removal of these glands does not noticeably impair the nutrition of the animal, from which we must infer that if any internal secretion is supplied by these glands "it must be one common in character and function with that of some other organ, or at least one which can with ease be vicariously supplied by another organ."

It is not my purpose here, however, to enter into detail regarding our knowledge concerning the internal secretions manufactured by the liver, kidneys, thyroid, pituitary body, suprarenals, etc., but I would emphasize the fact that information already accumulated shows plainly that all of these glands are active in the formation of internal secretions, all of which are endowed with marked physiological properties. No doubt, too, this metabolic activity characteristic of these several glands results, in some cases, in the formation of several physiologically active substances, some of greater importance than others. From this it is very evident that the general metabolism of the body must be more complex even than hitherto supposed, and that many of the functions of the body are dependent upon other functions more or less obscure.

* Journal of Physiol., Vol. 19, No. 4. Proceed. Physiol. Soc.

The manufacture of the specific substances which give character to the various internal secretions is obviously a function either of special cells contained in the gland, or it may be in some cases an inherent quality of all the cellular elements of a given gland. In the pancreas, the formation of the active agent is apparently limited to an interstitial epithelium-like tissue occurring in isolated patches throughout the gland, and especially characterized by its vascularity. This epithelioid tissue is certainly distinct from the secreting alveoli, and is suspected at least of being the source of the internal secretion. Again, in the suprarenals, as Schäfer and Oliver have shown, the active principle, which has such a marked influence upon the heart and arteries, is contained only in the medulla of the gland and not in the cortex, the medulla forming about one-fourth of the gland by weight.

However specialized the cells concerned in the manufacture of these physiologically active substances may be, they are certainly typical cells with distinct nuclear protoplasm and cytoplasm, and if one is to unravel the nature of the chemical processes by which the active agents are produced and learn their true origin, as well as their exact chemical structure, it becomes necessary to study the character of the material of which the cells are composed, and out of which the physiologically active principles are constructed. It is quite proper to say that these bodies originate through the metabolic activity of the cell, but such a statement carries with it little exact knowledge and throws little light upon either the nature of the process or the character of the resultant products. Further, as already indicated, we must not limit our conception of internal secretion to a few isolated glands, but keep clearly in mind the fact that wherever there is metabolic activity absorption of products is liable to occur, and is no doubt a constant feature of all glands and tissues, although obviously not all organs yield katabolic

products of vital importance. Yet, doubtless all of the so-called leucomaïnes formed throughout the body, especially in the muscular tissue and glandular organs, innocent though they are of any marked physiological action, do have functional power and are of aid in keeping up that physiological equilibrium so essential to the well being of the body, and for the smooth running of the vital machinery. We know well that any excessive accumulation of these normal leucomaïnes gives rise to noticeable disturbance of the system, and we already associate their presence under such conditions with definite symptoms. Why then should we not attribute some power to these substances when present in normal quantities, and give full recognition to their possible value as internal secretions?

In this broader sense, then, internal secretion must be going on all through the body and this aspect of the subject truly merits our careful consideration. At the present time, however, interest naturally centres around those more striking phenomena which pertain to those internal secretions, study of which has furnished clear proof of their vital importance. The physician well knows that failure of one or other of these internal secretions is a matter of vital import, while the recognition of such failure is necessarily the first step in the process of treatment. Again, experience has already shown that the physician may hope to avail himself of the active principles which the internally secreting glands afford, and in certain cases to use either their extracts or the active principles themselves in place of the hitherto more commonly employed vegetable medicaments.

Chemically considered, we have to-day a certain amount of knowledge concerning the nature of the active substances secreted by the thyroid gland and the suprarenals. In the case of the latter glands, the active principle is a body soluble in water and in dilute alcohol, insoluble in absolute alcohol, ether, chloroform, benzine, amyl

alcohol, etc. In aqueous solution, it dialyzes readily through parchment, the diffusate being entirely free from proteid. Hence, the active principle cannot be a proteid body. It is, moreover, fairly stable, not being destroyed by moderate boiling, nor by the action of acids, and it is also fairly resistant to the action of the gastric juice. It is however readily destroyed, *i.e.*, its physiological power is lost, through the action of alkalies, by oxidizing agents, and by continued boiling. It is apparently a powerful reducing body, and by oxidation, as with hydrogen peroxide, or with alkalies in the presence of oxygen, a rose red color is produced accompanied by rapid loss of physiological action. As to more definite knowledge concerning the chemical nature of the substance, we know nothing. It is plainly a very active substance, for as Schäfer and Oliver have shown, 5½ milligrams of the dessicated suprarenal gland, are sufficient to obtain a maximal effect upon the heart and arteries in a dog weighing 10 kilograms. But as the active principle is contained only in the medulla of the gland, and this does not form more than one-fourth of the gland by weight, and as full nine-tenths of the medulla are composed of proteid and other non-diffusible matter, it is calculated that 1-800 of a grain of the pure active principle is sufficient to produce distinct physiological results upon the heart and arteries of an adult man. The conclusion is therefore obvious that the actual amount of this substance elaborated by the suprarenal gland is exceedingly small, a fact which plainly stands in the way of a more thorough study of its properties. Enough is known, however, to show that this substance, which is of primary importance to the body, must result from very decided metabolic changes. Assuming its origin to be some one or more of the proteid molecules of the cell, it is plain from the non-proteid nature of the substance that its manufacture must be attended with profound secretory changes.

In the case of the thyroid gland we have evidence, thanks to the painstaking work of Baumann and his colleagues, that the physiologically active substance of this gland is an organic iodine compound — thyroiodin. This body manifests no proteid reactions, though on decomposition by heat it evolves an odor of pyridin bases. It contains a large proportion of nitrogen, and about 0.5 per cent. of phosphorus in organic combination, a fact which suggests the possibility of its being a direct cleavage product of nucleic acid. Thyroiodin can be prepared from the thyroid glands of man and animals, by boiling the glands with sulphuric acid, or by treating them with artificial digestive fluids, a fact which testifies to the comparative stability of the active substance. When purified, it possesses weak acid properties, is readily dissolved by alcohol and alkalies and in part by cold water. The iodine is in very firm combination, and is present in the molecule to the extent of 10 per cent. Only a small proportion of the thyroiodin obtainable from the gland exists in a free state, the bulk of the substance being combined with two proteids — an albumin and a globulin — the former predominating. From these compounds thyroiodin can be split off by the action of dilute sulphuric acid. Repeated experiments have demonstrated that the physiological activity of the thyroid gland, so noticeable in myxœdema, adipositas, etc., is due solely to the thyroiodin, and it is to be noted that excessive doses of this compound give rise to the same toxic symptoms that are frequently produced by the ingestion of large quantities of thyroid glands. This active principle of the gland undoubtedly makes its way to other organs. Baumann, indeed, has detected iodine in the thymus of the calf, and Professor Miculicz of Breslau has observed a decrease in the size of thyroids in goitre after repeated ingestion of thymus glands. At the same time it is evident that thyroiodin is not a product of general metabolism, but its formation is apparently restricted to

the thyroid gland, although the product once formed may be utilized in a variety of ways, and doubtless in different parts of the body.

All of the secretions of the body emanate from the functionally active cells of the various glands and organs, and the origin of the internal secretions is to be sought for in the metabolism of the gland cell. In the evolution and development of the different glands of the body we have tangible evidence of morphological differentiation, both as regards external form and as regards the constituent cells, and this no doubt is accompanied by a corresponding functional or chemical differentiation, the extent of which we are wont to measure by the variations in chemical composition, either of the gland or tissue as a whole, or of the external secretion which it manufactures. To this must now be added the composition and function of the internal secretions, which give a still wider variety to the many functions of the body. How are we to explain this variety of function so characteristic of the different glands? Where are we to seek for the origin of the many diverse products which are found in the different secreting structures? To the chemist only one explanation seems probable, viz.: that the different gland cells must be endowed with a distinctive form of cell protoplasm, and when this is called into activity under normal circumstances certain products invariably result from the very nature of the protoplasm, *i.e.*, from its peculiar chemical constitution. Every gland, organ and tissue of the body must therefore have its own particular kind of cell, and this personality is not to be considered as restricted to its morphology, but as applicable also to the chemical constitution of its cell protoplasm, upon which rests its function. In every animal cell we recognize at least two physiologically distinct parts, the nucleus with its contained karyoplasm and the body of the cell with its constituent cytoplasm, and in my judgment the so-called in-

herent qualities of a cell—its functional power—reside in the chemical nature of the groups and radicles which enter into the karyoplasm and cytoplasm.

According to this view functional differentiation is dependent upon the character of the anabolic processes; it is this which determines in great part the nature of the cell and the character of the products resulting from its activity. Hence, cell protoplasm is not an entity of ever constant chemical composition common to the cells of all glands and tissues, and yielding different products in different localities according to nerve or other influence exerted by the peculiar environment, but on the other hand there must be a typical form of cell protoplasm for each distinct group of cells, each form with enough individuality to admit of its certain detection on application of the proper tests. Abnormality of function may thus be due as much or more to perversion of the anabolic processes of a cell or group of cells, as to any direct modification of the katabolic processes; in other words, modification of the anabolic processes results in the formation of what might be called an abnormal protoplasm, and this necessarily leads to the formation of peculiar or abnormal products, recognition of which constitutes the best and perhaps only proof of the abnormality.

These views being correct, it is quite misleading to speak in the general way frequently adopted of cell protoplasm and its primary constituents. In other words, the primary constituents of one group of cells, as in the thymus, for example, must be of a different nature from those common to the protoplasm of the liver cells. Hence, there are no primary constituents common to all forms of cell protoplasm, but each variety of cytoplasm and karyoplasm, in my judgment, has its own peculiar make up. By this I do not mean that the various forms of cell protoplasm necessarily existant in the human body are superficially, at least, as varied in composition as the products which emanate from

the activity of the various glands and tissues. With large and complex molecules, such as are common to living protoplasm, considerable variety may be introduced into the structure without leading to any very great external difference, but if we could only unravel and spread out before us the many simple groups that enter into the make up of the varied forms of complex protoplasm, I fancy the differences would be even more striking than is suggested by the character of the products which result from the breaking down of the various forms of glandular protoplasm.

Superficially, however, cell protoplasm, whatever its origin, has a certain uniformity of composition, and the body or bodies which stand out most prominently as characteristic of the cytoplasm and karyoplasm of all active cells, are a peculiar group of compound proteids known as nucleoalbumins or nucleoproteids, all characterized by containing more or less phosphorus. A few years ago our knowledge of these bodies was very limited—and indeed it is none too complete today—but recently our knowledge has been growing very rapidly and we are learning that under the name of nucleoproteids, nucleoalbumins, nucleins and nucleic acids we have to deal with a class of very remarkable bodies which constitute the greater part of the nucleus and cytoplasm of nearly all cells, and which evidently play an all-important part in every form of cell metabolism. Proteid or albuminious bodies have long been known as the chief constituents of protoplasm, but we now understand that it is not as simple proteids that these bodies exist in the cell, but mainly as compound bodies, *i. e.*, as combinations of nucleic acid with some form of proteid or albuminous matter.

Between the cytoplasm and karyoplasm of a cell the cytologist recognizes a distinct and usually constant difference, which shows itself at once on the application of appropriate dyes. The nucleus of the cell we say is rich

in nuclein, while the cytoplasm, and perhaps the nucleoli as well, are characterized by the presence of nucleoalbumin with a less marked affinity for dyes. But nucleins and nucleoalbumins or nucleoproteids differ from each other simply in the proportion of proteid and nucleic acid which they contain. The bodies of this class are all acid bodies, of weak acidity to be sure, and with a varying degree of acidity, but sufficiently marked in every case to suggest the presence of some form of acid radicles. This fact, indeed, led to the discovery of nucleic acids, bodies readily obtainable from all forms of true nucleins by the action of dilute alkalies, the latter seeming to break up the combination existing between the acid and the albuminous matter with which it is naturally combined. A so-called nuclein is thus seen to be simply a combination of some form of proteid matter with a nucleic acid, while a true nucleoproteid or nucleoalbumin is a combination of a nuclein with more albuminous matter.

Nucleic acid, as ordinarily prepared, is a white amorphous powder of strong acid reaction, readily soluble in water containing a small amount of alkali, and with a strong affinity for proteid matter of all kinds. In composition, nucleic acid is characterized by its large percentage of phosphorus, as much as 9 or 10 per cent. of this element being found in some forms of this acid. According to Kossel, the proportion of nitrogen and phosphorus in all nucleic acids is as 3 to 1. But while all forms of nucleic acid may contain a certain definite proportion of nitrogen and phosphorus, they differ from each other very decidedly in their inner structure, as indicated by the character of their cleavage products. Indeed, it was only by studying the decomposition products of nucleic acid from various sources that a suggestion was obtained of the existence of different forms of this acid. Thus, if the nucleic acid separated from the cells of the thymus gland be boiled

with dilute sulphuric acid it yields a large amount of a peculiar nitrogenous base called adenin, with some guanin and the new base cytosin. On the other hand, the nucleic acid obtainable from the sperm of steers yields by similar treatment not adenin, but mainly xanthin, hence this acid may be appropriately termed xanthylic acid. Again, the nucleic acid obtainable from yeast cells yields on decomposition four distinct nitrogenous bases, viz., xanthin, guanin, adenin and hypoxanthin, from which we infer that this particular acid is in reality composed of several, possibly four, distinct varieties of nucleic acid.

Another fact which implies the existence of even a greater variety of nucleic acids is found in the presence of carbohydrate groups in some acids. Thus, the nucleic acids obtainable from the cells of the pancreatic and mammary glands, as well as those prepared from yeast cells, yield by cleavage a reducing carbohydrate, while from the acid of the thymus gland, lævulinic acid has been obtained. In some other forms of nucleic acid, on the other hand, no carbohydrate groups can be detected. Again, there are some forms of nucleic acid — so-called paranucleic acids — from which no nuclein bases whatever can be obtained by decomposition. Hence, it is very evident that under the head of nucleic acids we have to deal with a large class of closely related bodies, superficially showing a close resemblance in general reactions and properties, but with a diversity in inner structure clearly suggestive of corresponding differences of function.

Some one or more of these acids are to be found in every active cell of the body, generally not free, but ordinarily combined with more or less proteid matter of some kind to form the various nucleoproteids and nucleins which, in great part, compose the karyoplasm and cytoplasm of all living cells. The properties and general characters of the nucleoproteids and nucleins, and hence likewise of the

karyoplasm and cytoplasm of the cell, depend mainly upon the amount and character of the nucleic acid united to the proteid. Generally, the nuclear protoplasm is rich in nucleic acid as indicated by its high content of phosphorus and by the character of the stain yielded by certain dyes. The cytoplasm on the other hand usually contains a smaller proportion of nucleic acid with a larger admixture of proteids; *i. e.*, the cytoplasm is mainly composed of nucleoproteids with a comparatively low content of phosphorus. Variations in the amount and character of the nucleic acids, as well as of the proteid, existant in the nucleins and nucleoproteids of cell karyoplasm and cytoplasm obviously affect the ordinary reactions of the protoplasm; but of still greater importance, physiologically, is the influence exerted by this variability in determining the functional peculiarities of cell protoplasm; a variability which may well be assumed as all sufficient to account for the peculiar lines of metabolism characteristic of the individual glands and tissues of the body.

If we take the content of phosphorus as a measure of the proportion of nucleic acid contained in the various forms of nucleoproteids thus far studied, we find exceedingly great variations in the amount of this acid present in the molecule; a fact which may be taken as evidence of the large number of molecular combinations present in the protoplasm of different cells. Thus, from the kidneys we obtain a nucleoproteid with only 0.37 per cent. of phosphorus, while as representing the other extreme we have in the pancreas a nucleoproteid containing 4.71 per cent. of phosphorus and in the lymphoid cells of the thymus a corresponding body with 3.5 per cent. of phosphorus. While these various combinations, modifying as they do the composition of the cell protoplasm, are of the greatest moment in determining the metabolic activity of the cell, of far greater importance is the variable character of the nucleic acid present in the

plasma, since this introduces an element which may well determine the line of metabolism. Variation in the quality and quantity of the chemical material entering into the structure of the karyoplasm and cytoplasm of the cells of the body is thus clearly indicated, and the character of the most variable elements—the nucleic acids—may well attract our attention as offering a tangible explanation of one cause, at least, of the striking individuality of the various gland cells. In the structure of the individual nucleic acids, with their marked tendency to yield specific nitrogenous bases, bodies which are common katabolic products of many glands and tissues, we see a plausible opportunity for explaining the origin of many substances characteristic of both external and internal secretions. I must admit there is much that is theoretical in this suggestion, but I know of no line of study which offers equal inducements in the way of explaining the origin of the peculiar bodies which give character to the internal secretions. The very nature of the many bases which come from the cleavage of the nucleic acids outside of the body; the ready convertibility of these bases into other allied bodies by oxidation and reduction; their own physiological action, which though mild is marked; the possibility, nay the probability, that many other katobolic products may be obtained from these nucleic acids; and further that still other nucleic acids, at present undiscovered, may exist in the cell protoplasm; all offer good reasons for believing that the nucleins and nucleoproteids, which are the most prominent constituents of the protoplasm of all cells, are the most probable antecedents of the internal secretions.

In conclusion, allow me to say with reference to nucleins and nucleoproteids that due consideration should be given to the probable difference in physiological action of the several nucleic acids. We all, I am sure, believe in the close relationship existing between chemical constitution

and physiological action, and since it is very evident that the specific nucleic acid of the thymus is quite different in chemical constitution from xanthylic acid, for example, it follows that corresponding differences in physiological action may likewise exist. Consequently, if so-called nuclein therapy is to have a legitimate trial it is to be hoped that ultimately distinct forms of nucleic acid, nucleins, etc., may be available for the use of the pharmacologist and the clinician.

ARTICLE VIII.

ANTITOXINE IN THE TREATMENT OF DIPHTHERIA.

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ANTITOXINE IN THE TREATMENT OF DIPHTHERIA.

It is the generally conceived opinion that physicians are exceptionally conservative in accepting any new remedy for the treatment of any special disease, and it is well that it should be so; for only by careful investigation of the results of any special mode of treatment can we hope to arrive at the truth. Statistics of the result of any method of treatment of a special disease, to be of value, must be based on a large number of cases and must continue for a very considerable period of time. It is also important that the cases should be observed until absolute recovery takes place. Antitoxine has now been in use something over three years, and the consensus of opinion is that it is a remedy of great value in the treatment of diphtheria. It has not, however, proved of advantage in far advanced septic cases of this disease, neither has it been shown to be of any value in the later symptoms characterized by failure of the heart's action and a general degeneration of the nerves. While it is not claimed that antitoxine will cure every case of diphtheria, it is claimed, and an analysis of the following statistics proves, that the serum of horses rendered immune to the toxine of diphtheria is one of the most valuable agents in the treatment of diphtheria. In the Boston City Hospital in 1891 there were 237 cases of diphtheria treated, with 105 deaths. In 1892–3 there were 387 cases treated, with 185 deaths. In 1893–4 there were 438 cases treated, with 203 deaths. In 1894–5, when anti-

toxine was used only in a comparatively small proportion of cases, there were 698 cases treated, with 266 deaths, making a total of 1760 cases with 759 deaths, with a percentage of 43, which was about the average death-rate of diphtheria in hospital cases both in this country and in Europe. In private practice the death-rate as a rule is not quite so high as in hospital cases, simply from the fact that the severe cases only are sent to the hospital. In Boston, from 1878 to 1894, the average death-rate in the city was 30.7. The lowest death-rate was 27.18 and the highest 35.7. As this comprises 24,813 cases, the average fatality of the disease can be readily seen. In the South Department of the Boston City Hospital, from the first of September, 1895, to the first of May, 1896, when every case was treated with antitoxine, there were 1359 cases of diphtheria treated, with 170 deaths, giving a percentage of 12.50. In the year 1895 throughout the whole city there were 4059 cases reported to the Board of Health, with 588 deaths and a percentage of 14.48. These cases reported to the Board of Health include many mild cases and therefore cannot give a proper idea of the death-rate of this disease. Some of these cases were without doubt treated with antitoxine, but how many it is impossible to state. The cases in the South Department of the Boston City Hospital, on the other hand, were nearly all of them severe cases and in many instances the membrane covered the tonsils, the uvula and nearly the whole of the roof of the mouth, with extensive swelling of the cervical glands. As a rule patients are not sent to a hospital unless they are seriously ill, and for this reason statistics based on hospital cases give a much better idea of the benefit of any prescribed method of treatment than can be obtained from cases in private practice. It is claimed, and with truth, that in the first year of life diphtheria is an extremely fatal disease, the majority of patients succumbing to it.

An analysis of the cases at the hospital shows that in eight months there were 17 cases admitted under one year of age with three deaths, giving a percentage of 17.6. The number of patients from one to two years old admitted was 74 with 20 deaths, giving a percentage of 27; from two to three years of age there were 136 patients admitted with 37 deaths, giving a percentage of 27; from three to five years of age 329 patients were admitted with 55 deaths, a percentage of 16.7; from five to ten years there were 410 patients admitted with 39 deaths, giving a percentage of 9.5; from ten to twenty years 187 patients with 9 deaths, giving a percentage of 4.8; and from twenty years and upwards 206 patients with 7 deaths, a percentage of 3.4. All of these cases were treated with antitoxine, and it would seem that these statistics should convince any one of the beneficial effects of this agent. If we take the highest death-rates occurring in any of these ages, namely that from one to two years, and also from two to three years, children of these ages being particularly susceptible to the disease, and in whom diphtheria plays the greatest havoc, we find that the death-rate is 27 as compared with 43 before antitoxine was used—a marked diminution.

In the epochs of life from five to ten years, from ten to twenty years, and from twenty years upwards, there is an extremely low death-rate, being respectively 9.5, 4.8 and 3.4. There would seem to be only one explanation of this low death-rate. In all of these cases antitoxine was administered within a very short time after the admission of the patients. Bacteriological examinations were made in every instance, but it was not deemed advisable to wait for the result of the cultures before administering the serum. In order to obtain the best results from the use of the anti-diphtheritic serum, it is important to administer the agent early in the disease. A delay of 24 hours after the appearance of the membrane frequently imperils the lives of the patients. In

a case of well-marked clinical diphtheria the time necessary for the growth of the organism in the culture tube is lost, but it is very important that cultures should be made in each and every case of diphtheria in order that statistics may be based on a scientific foundation. The failure to obtain a positive result has occurred so seldom as not to be a factor of the slighest value, as this failure has been due to some error in technique. The importance of the early administration of antitoxine is shown by an examination of the statistics of the hospital. Of the 1,359 cases admitted 53 died within 24 hours of admission, and of these 53 quite a large number died within two or three hours. If we eliminate these 53 cases we have 1,306 cases and 117 deaths, a percentage of 8.9. If we eliminate the 74 deaths that occurred within 48 hours of admission, we have a percentage of 7.4.

Table of the number of cases of diphtheria, treated at the Boston City Hospital, with the deaths, by ages, from Sept. 1, 1895, to May 1, 1896:—

Ages.	Cases.	Deaths.
1 year	17	3
1–2 years	74	20
2–3 "	136	37
3–5 "	329	55
5–10 "	410	39
10–20 "	187	9
20 years and upwards	206	7

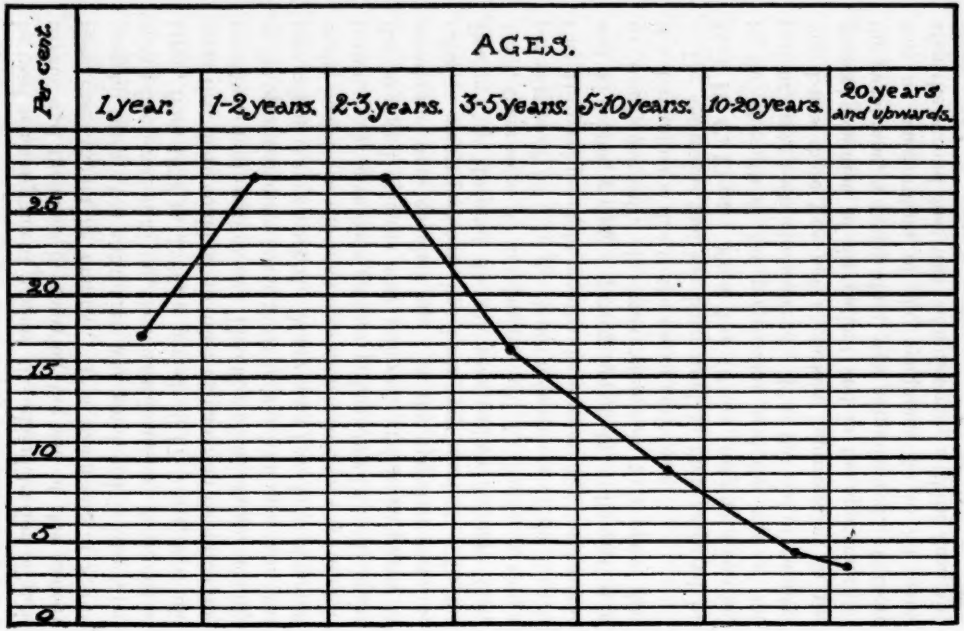
Cases in which antitoxine was used:—

1359 with 170 deaths, per cent. 12.50.

Cases from February, 1891, to February, 1894, in which antitoxine was not used:—

1062 with 493 deaths, per cent. 46.

CHART OF THE PERCENTAGE OF DEATHS FROM DIPHTHERIA, BY AGES, AT THE SOUTH DEPARTMENT OF THE BOSTON CITY HOSPITAL, FROM SEPT. 1, 1895, TO MAY 1, 1896.



It is manifestly evident that moribund cases should not be used as an argument against the administration of antitoxine, and therefore in studying the use of this remedy these cases should be omitted. If a death-rate of 8.9 in hospital cases when antitoxine was employed is compared with a death-rate of 27.06, the lowest death-rate in the city at large, from 1878 to 1894, a period of 17 years, it would seem that there could be no other explanation than that this result was due to antitoxine. The effect of antitoxine, not only in the operative cases but in those in which an operation was impending, is very marked. Many cases have been observed at the hospital in which an operation before the days of antitoxine would have been necessary, but after 18 to 24 hours the laryngeal stenosis was relieved, and large pieces of membrane were coughed up. In the operative cases the relief in many instances has been very marked. In the Boston City Hospital for the year ending January 31st, 1895, there were 89 intubations and 74 deaths, giving a percentage of 83. In the South department of the Boston City Hospital for eight months there were 136 intubations and 63 deaths, giving a percentage of 46, a diminution of 37, nearly one half. It seems reasonable to suppose that this diminution is due to the use of antitoxine.

The antitoxine that has been used is that prepared by Prof. H. C. Ernst. From 5 to 10 c.c., varying according to the strength of the preparation and the age of the patient, have been administered. If at the end of twenty-four hours there was not a marked improvement in the general condition of the patient and in the appearance of the membrane, a second dose was administered. If there was no amelioration of the symptoms 24 to 32 hours after the second dose was administered, a third dose was given, and in certain instances a fourth dose. The appearance of the membrane in favorable cases caused by the action of the antitoxine is very characteristic. The

membrane commences to be detached at the edges, is undermined and begins to roll up. This appearance is so characteristic that when it has occurred a second dose has not been given. In no instance has the membrane ever re-formed to any considerable extent. In septic cases the septic odor in the majority of instances has been less apparent after the administration of antitoxine. The stronger the antitoxine is, the better; because it is necessary to inject a less quantity, as can be readily understood. An injection of 20 c.c. into the cellular tissue causes quite a perceptible tumor, and is a source of annoyance to the patient, therefore a preparation in which the requisite dose is from 5 to 10 c.c. is better than one in which the dose is 20 c.c. The method of estimating the dose of antitoxine by normal units is perhaps the better one. An antitoxine unit is an amount of serum required to protect a guinea pig weighing 500 grammes from the minimum fatal dose of the toxine of diphtheria. The number of immunity units per c.c. would give the strength of the serum; for example, one one-hundredth of a c.c. would protect a guinea pig weighing 500 grammes, and for a person weighing 120 pounds, or about 50,000 grammes, 1 c.c. would be required for procuring immunity. For the cure of the disease, however, fifteen or twenty times as large a dose is required, namely, 1,500 to 2,000 units.

In no instance has any serious effect followed the use of antitoxine at the hospital. In a few instances abscesses have appeared at the point of injection. Cultures made from the contents of these abscesses showed a pure growth of streptococci, and as abscesses are not infrequently concomitants of diphtheria, it is reasonable to suppose that the injection of antitoxine was only an exciting cause of a predisposing condition of the system. As illustrating this point, two sisters with severe attacks of diphtheria were injected at the same time with the same specimen of anti-

toxine. One had a large cervical abscess from which a pure culture of streptococci was taken, the other had a small abscess at the point of inoculation which also gave a pure growth of streptococci. The injection of antitoxine had certainly nothing to do with the cervical abscess and it is at least doubtful if the injection was the direct and immediate cause of the second abscess. It is a significant fact that pure cultures of streptococci have been obtained from all the cervical abscesses at the hospital occurring in the course of diphtheria.

Severe joint pains have been noticed in five instances. These attacks have generally lasted from twenty-four to forty-eight hours, and have been a source of annoyance to the patients, but in no instance have they been an element of danger.

Urticaria has occurred in quite a number of cases, and although this has been a cause of discomfort to the patient, it has never been a grave symptom. Dermatitis resembling the eruption of a severe attack of scarlet fever in which the diagnosis for the first twenty-four hours was impossible, has been noticed in a few instances. The moderate rise in the temperature, the absence of vomiting and the subsequent history of the case confirmed the diagnosis of antitoxine rash. An eruption resembling measles has been noticed a few times. From the appearance of this eruption it would be impossible to make a differential diagnosis, but the absence of constitutional symptoms has been an aid in deciding upon the nature of the eruption.

In the mixed cases of scarlet fever and diphtheria, antitoxine has had a beneficial effect upon the diphtheritic membrane, but of course has had no effect on the attack of scarlet fever. In addition to the use of antitoxine, alcoholic stimulation has been very freely used; digitalis, strychnia and atropia have been used in suitable cases. Milk has been the principal article of diet, and has been given in as

large quantities as the patient could be induced to take. In certain cases where the patients absolutely refused to take food and stimulants, nasal feeding has been tried, and in some instances this seemed to be the turning point, and the patient's life was apparently saved by this procedure. It is not sufficient to simply give antitoxine and do nothing else for the relief of the patient. In no disease are food and stimulants more imperatively demanded than in diphtheria, and an attempt has been made to give food and stimulants in any way in which they could be absorbed. A word may be said regarding nasal feeding. It is less annoyance to the patient, it causes less strain on the nervous system in some instances to give food by the nasal tube than by the mouth. The constant endeavor to make a patient take food by the mouth is a much greater injury to him than the passage of a small rubber catheter through the nose into the stomach. The beneficial effects of this method of feeding have been illustrated in so many instances at the hospital, that I may be pardoned for alluding to it in somewhat strong terms. The less you annoy a patient ill with diphtheria the better for him. There is no doubt in my mind that many a diphtheria patient has been harried to death by over zealous attempts to induce him to take nourishment.

Irrigation with a hot saline solution, and in some cases a solution of corrosive sublimate one part to ten thousand, has been the application that has been used for the nose and throat, and the relief experienced by patients from this has been very marked. The less one interferes with the membrane the better for the patient. The irrigation removes all particles of membrane that are easily detached, and does not leave an abraded surface to serve as a focus for the extension of the membrane. The forcible detachment of the membrane by forceps cannot be too strongly deprecated. The use of caustics is of no advantage.

The experiments of Roux and Yersin show conclusively that diphtheritic membrane is less likely to extend on intact mucous membrane than on abraded surfaces, and therefore when the mucous membrane is in anyway injured an opportunity is given for the extension of the disease.

Albuminuria has not been increased to any considerable extent by the use of antitoxine. An analysis of eighty-three cases at the hospital, in which the urine was examined before and after antitoxine was administered, showed that in thirty-eight cases albumen was absent; that in thirty cases there was the same amount of albumen before and after antitoxine was given; that in eleven cases albumen was diminished after the injection, and that in four cases albumen was increased. Of these four cases, in two the amount of the increase was from nothing to the slightest possible trace, and in two the amount was increased from a trace to a large trace. In no instance have renal complications given rise to serious symptoms. Albuminuria is such a frequent complication in diphtheria that any statistics, to be of value regarding the action of antitoxine on this condition, must embrace a great number of cases, and the examination of the urine must be made before and after the administration of the agent. Observers who have claimed that antitoxine causes albuminuria in diphtheria have in many instances failed to test the urine before antitoxine was used, and many of these observers lose sight of the fact that albuminuria is one of the most constant symptoms in severe cases of diphtheria.

No cases of anuria have been observed at the hospital.

Paralyses have been observed in a comparatively small number of cases, the percentage being somewhat less than was noted before the days of antitoxine. When the cases have been received early in the history of the attack, before the growth of the organism was sufficient to generate a great amount of toxine, paralysis has not as a rule occurred.

If, on the other hand, the case was received late in the course of the disease and the membrane was extensive, paralysis more or less marked has occurred in the majority of cases. Cases of sudden death so common in the convalescence of diphtheria have not occurred, but there have been a few cases in which after apparent convalescence there would be an attack of vomiting and the patient rapidly lose strength and gradually sink and die in from 24 to 72 hours from the commencement of the attack. Broncho-pneumonia has been one of the most frequent causes of death, and no one claims that antitoxine has any remedial power in this condition. If all the cases of death from broncho-pneumonia were eliminated, the death-rate from diphtheria pure and simple, when antitoxine is used, would be much lower than that that has been previously given.

In the laryngeal cases intubation has been the operation generally selected, as this operation has in every instance relieved the stenosis. The advantages of intubation are first, a minimum amount of shock, and second, there are no cut surfaces to afford soil for the growth of not only the diphtheria baccilli but of other bacteria, for no matter how carefully you may carry out aseptic precautions it is impossible to keep a tracheotomy wound aseptic as can be done in other surgical operations. There can be no doubt that the fatal issue in cases of tracheotomy is due in most instances to an infection either through the wound or through the orifice of the tube itself. In the few cases of tracheotomy at the hospital, death was caused by this very infection. Another advantage of the intubation tube is the fact that the air that enters the lungs passes through the natural channels and therefore is less likely to irritate these organs. One argument that has been used against intubation is that the patient is unable to take the requisite amount of food; but this is obviated by the use of nasal

feeding, which has been a very important factor in reducing the death-rate. That antitoxine has also been a very important factor no one can reasonably doubt who has observed intubation cases before antitoxine was used and since its adoption.

The site of the injection has been in some instances the outer aspect of the middle third of the thigh, the lumbar region and the upper third of the thorax near the posterior axillary line. After a careful consideration of these various positions, it seems to me that the last situation is the best, for the reason that any irritation and swelling in this locality causes less annoyance to the patient than in either of the other localities. One very important advantage is also that in this place the nervous distribution is comparatively limited, and therefore the amount of pain is diminished to a minimum. The technique of the operation is as follows: First, the parts are rendered aseptic by washing with corrosive sublimate; second, the syringe and needle are carefully sterilized by boiling. The antitoxine is strained into the barrel of the syringe through sterile gauze. A fold of the skin is taken up by the thumb and fore finger, and the needle plunged deeply into the cellular tissue. The injection is then made slowly and carefully with only a limited amount of force. After the needle is removed the opening in the skin is sealed with gauze and collodion. If the injection is properly given there should be no tumor and therefore no necessity of rubbing the parts in order to cause the disappearance of the tumor as is recommended by certain observers. Williams's syringe, which consists of a glass barrel and a glass piston with asbestos packing, is the instrument that has been used. Koch's syringe, which consists of a glass barrel with a detachable rubber bulb, is a very good instrument for this purpose. Lüer manufactures a very good syringe. One advantage of Lüer's syringe is, that there is no packing to become worn, as the piston is

carefully ground to fit the barrel. The only objection to this syringe is its high cost. As a matter of fact it makes very little difference what kind of a syringe is used so long as each and every part can be thoroughly and absolutely sterilized by heat without injury. A small needle should always be used, for with a minute puncture the danger of infection is diminished.

The preparation of antitoxine, and its use in the treatment of diphtheria, are the results of careful and laborious work of bacteriologists, and whatever advantage has been gained in the treatment of diphtheria is due to the science of bacteriology. It has been claimed that the use of antitoxine is unscientific, but any one who has carefully read the reports of Roux, Yersin, Aronson and many others cannot fail to be struck with the eminently scientific nature of their work. As the preparation of antitoxine requires great scientific knowledge and an unlimited amount of time and patience, it is evident that in order to be a success, from a commercial point of view, the price must be so high as to place it out of the reach of the poorer classes, and therefore it is incumbent on State and City Boards of Health to make arrangements whereby the serum can be distributed gratuitously or sold at a nominal price. As has been before stated, all the antitoxine used at the hospital has been prepared by Dr. Ernst, and there can be no doubt that the satisfactory results obtained have been due to the excellence of this preparation and the careful manner in which it has been prepared.

In this paper a short and imperfect account of the work in the diphtheria wards of the hospital has been outlined, and certainly a diminution of the death-rate from 46 per cent. when antitoxine was not used, to one of 12.50 when it was used, can only be explained by the remedial power of this agent. If many cases of death occurring in persons ill of diphtheria, but in whom the cause of death was other

than diphtheria, had been eliminated, the death-rate would have been much lower; but as it has been the object of this paper to show the true value of antitoxine, in the treatment of diphtheria, it has been deemed advisable to err against antitoxine rather than for it.

ARTICLE IX.

TREATMENT OF DISEASES OTHER THAN DIPHTHERIA BY ANTITOXINES.

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TREATMENT OF DISEASES OTHER THAN DIPHTHERIA BY ANTITOXINES.

DURING the last few years, and notably in the last two years, great advances have been made in the treatment of diseases dependent upon the growth of bacteria. From reports received from all parts of the world and corroborated by practical experience in private practice in Boston and in the contagious hospital of this city, we have reason to believe that at last we control a specific capable of curing diphtheria if applied early in the disease and in the proper manner. A comparison of the death rate from diphtheria at the Boston City Hospital during the last year with that of preceding years, is the most eloquent testimony that can be given of the brilliant and successful labors of Dr. H. C. Ernst as superintendent of the city laboratory for the production of diphtheria antitoxine.

The application of antitoxine in the treatment of disease is the result of long-continued, patient, logical work in the pathological and bacteriological laboratories of France, Germany and Italy; just now it is of importance to properly consider the sources from which we have gained this powerful aid in the treatment of disease, as the advance of science has been threatened by the crusade of the antivivisectionists, undoubtedly of good intentions though in their judgment led sadly astray.

It is difficult to decide definitely to which investigator the final honors are due, as so many have by their labors

added something to the final successful issue of the work. Recently the French government has most honorably divided between Behring and Roux a sum of money awarded in consideration of the discovery of the diphtheria antitoxine.

We have as yet no definite proof as to what an antitoxine is. It is produced in the body of an animal that has successfully resisted a disease produced by a bacterium, for instance the bacterium X. If this antitoxine is injected into a healthy animal it renders the animal immune against inoculation with the bacterium X; further, if the animal is already suffering from a disease produced by the bacterium X it may be cured by the injection of a proportionally much larger quantity of antitoxine. There are two theories as to the therapeutic action of antitoxines: (1) that the antitoxine by chemical reaction neutralizes the toxine produced by the bacterium; (2) that it by some unknown property enables the cells to resist the action of the toxine. The amount of antitoxine necessary to protect or cure an animal increases by geometrical progression with the time elapsed since the inoculation. That is, a small amount of antitoxine is sufficient to render an animal immune to the action of the bacterium X, whereas a very large amount is necessary to cure an animal suffering from an advanced form of a disease caused by the same bacterium.

Practically, the results which we may hope for from the therapeutic use of the antitoxines are the prevention of further action by the bacteria, and the arrest of pathological processes set up by the action of the bacteria. To take diphtheria as an example: after the injection of a sufficient amount of antitoxine the membrane does not as a rule spread; the toxæmia produced by the growth of the bacilli does not increase in severity, and unless the individual is already too much affected there follows recovery. But, on the other hand, the antitoxine apparently produces no effect upon pathological processes already induced by

the bacilli; hence it has not been the experience that paralysis is less frequent since the introduction of antitoxine, in some clinics more frequent, probably in that more recover. It is important to bear this in mind when we come to consider what we may hope for from sero-therapy in tetanus; we cannot expect to cure central nervous lesions already produced by the action of the tetanus bacillus, but only to prevent at most the further invasion of healthy parts by the bacilli.

Experimental work was begun on diphtheria and tetanus at about the same time, tetanus being the first subject taken up. Soon after, in 1892 and 1893, Klemperer published his researches as to the treatment of pneumonia by sero-therapy; he succeeded in rendering mice immune to inoculation with the pneumococcus by injecting the serum of dogs that had recovered from inoculation with the pneumococcus. The serum which he produced also possessed certain but not marked curative properties. He reported in 1893 the treatment of six cases of pneumonia in the human subject with serum, and obtained results that led him to consider the method advantageous. Mosny, Bonone, Emmerich and Pansini obtained practically the same results as Klemperer in animal experimentation, but as yet no results of practical importance have been obtained in the treatment of pneumonia in man. In 1894 Hughes and Carter reported the injection of the serum of patients just recovered from pneumonia in ten cases; they had no reason to consider the treatment efficacious. Theoretically, such results seem to me such as we should expect, as from analogy we could not expect to materially affect a lung already diseased by the employment of an antitoxine serum; we should be able to prevent the spreading of the disease to areas not already affected.

Important work has been done as to the treatment of tetanus, and on the whole the results are such as to encourage us to further experimentation in this line.

In the last year much work has been accomplished in the diseases produced by the streptococcus, though this and the treatment of tuberculosis by sero-therapy must still be considered as in the experimental stage.

TETANUS.

The only important factor as to the etiology of this disease which can be drawn from the writings of the older surgeons are, first that it is more apt to follow lesion of the extremities, caused by crushing or tearing, and second that it is more commonly found in wounds which have been contaminated with earth or dust. Thus Baron Larrey reports one hundred cases of tetanus after a battle, in which many of the wounded had lain on the battlefield through a cold and stormy night.

Three hundred and ninety-five cases of tetanus—injuries of extremities 84% . Cushing gives 128 cases—injury of extremities in 110. In our late war—twenty-eight thousand injuries of foot or hand; ninety-four cases of tetanus.

Recent investigation as to the cause of tetanus offer an explanation of this clinical observation, in that the tetanus bacillus is an organism widely distributed in garden earth, the dust of streets, and in dusty places.

Two Italian physicians in 1884, Carle and Rattone, first established experimentally the transmissibility, and therefore the infectious nature of tetanus; rabbits inoculated from a case of human tetanus died of the disease. They demonstrated the infectious nature, but not the infective agent of tetanus. In 1885 Nicolaier found that garden earth produced the disease in animals, and obtained impure cultures of great virulence.

In 1886 Rosenback produced tetanus in animals by inoculating them with a bit of tissue from a man dead of tetanus; he found and named them "drum-stick" bacilli of

tetanus in the tissues of the man and in the animal; his cultures were not pure, but were virulent. Many experimentors confirmed these observations.

In 1889 Kitasato obtained pure cultures of the tetanus bacilli, having destroyed other organisms present by the application of a temperature of 80° cent.; his description of the bacilli is accurate and stands to-day unmodified.

The tetanus bacilli grow by spore formation, hence it is difficult to kill them. Experiments have shown that boiling for five minutes destroys the spores of tetanus, while they are resistant to strong chemical reagents.

The practical conclusion for the surgeon can be drawn, that instruments should be sterilized by boiling, as unfortunately tetanus is not unknown as a sequel of surgical operations, and has been observed where healing by first intention has taken place, showing the absence of the ordinary pus-producing organisms.

Dec. 4th, 1895, Behring and Kitasato published an article in the "Deutsch Med. Woch." on "The Origin of Immunity to Diphtheria and Tetanus in Animals." The work which led up to this article was based on the theory that acquired immunity depended upon some property of the blood serum, and that a chemical property, in opposition to the previously entertained theories as to the importance of the cellular elements of the blood in combatting disease. They claim not only to render animals immune to tetanus, but to cure the disease already established. In this article an important point is demonstrated, namely, that the serum of an immune animal, what we now call "antitoxine," would destroy a virulent culture if the two were mixed in the proportion of 1–5 c.c. In Volume XII. of the "Zeitschrift für Hygiene" published in 1892 are several articles by Behring, Schutz and Kitasato, continuing and elaborating their work on immunity and the therapeutic effects of blood serum. Large animals are rendered

immune by injecting cultures of tetanus whose virulence has been reduced by the addition of chemicals, either the trichloride of iodine or Gram's solution of iodine and iodide of potash. Behring again asserts that the curative serum will cure an advanced tetanus of animals. Tizzoni and Catani, in the "Cent. für Bact." (Vol. IX. pp. 180 and 685), review Behring's work and give their methods for producing antitoxine. They are sceptical as to the curative effect of the serum, if the tetanus has reached an advanced stage. In the latter article we first find a chemical analysis of antitoxine, from which we may say: —

1. It is an albuminoid body, as shown by the fact that its power is destroyed at a temperature of 68° cent., and not affected by a temperature of 60°.

2. It cannot be dialysed.

3. Mineral acids and alkalies destroy it.

4. An alcoholic precipitate dried *in vacuo* retains all the properties of the original serum.

Roux and Vaillard (Annales de l' Institut Pasteur, February, 1893) present a most important article. They obtained a powerful serum, estimating its strength, according to Behring's method, as 1 to 1,000,000; that is, 1 c.c. of the serum is capable of rendering immune 1,000,000 grammes weight of mice.

They succeeded by increasing doses in producing a serum in the horse of a protective power of 1 to 10,000,000.

All observers agree as to the possibility of rendering animals immune to tetanus. It is otherwise as to the curative properties of the serum. Tizzoni and Catani, Kitasato, and Roux and Vaillard, do not succeed in curing animals, as was so enthusiastically claimed by Behring. Furthermore, Behring in the "Zetschrift für Hygiene" (Vol. XIII. p. 193,) gives in detail many experiments as to the curative value of the serum. The minimal fatal dose of toxine was determined. If the dose of toxine employed was 100

times the minimal fatal dose, the quantity of serum necessary to render the animal immune, was increased not 100, but 10,000 times. Further, they found that when mice received twice the fatal dose no curative treatment was of avail if applied twelve hours after the onset of tetanic symptoms. Roux and Vaillard assert that at the moment of the first onset of tetanic symptoms there is already a sufficient amount of toxine in the system to kill the animal.

As a whole, the experiments on animals as to the curative value of serum do not lead us to expect brilliant and unfailing results in the treatment of tetanus in man. Such results might be expected, as I have stated before that so far as we can judge the action of an antitoxine is to prevent the further spread of a disease, and not to cure already established pathological processes.

In drawing conclusions as to the curative value of a treatment in tetanus, we must consider several factors of importance in forming a prognosis in cases of tetanus. It may be acute, chronic or subacute. The mortality of acute tetanus, calculated from a large number of cases, may be estimated as 80–90 %. Chronic, 50%. The longer the period of incubation, the less the mortality; also, the longer the duration of the disease after the onset of symptoms the better is the prognosis. The chances are much improved if the patient lives five days.

As to the prognosis of tetanus, the following data may quoted:

Richter.

25 Cases,	Incubation,	1–5 day	1 Rec.	4%.
91 Cases	"	6–10 days	4 "	4.4%.
54 Cases	"	11–15 days	14 "	27%.
20 Cases	"	15–20 days	9 "	45%.
15 Cases	"	over 20 days	3 "	20%.

Roland.

25 Cases,	Incubation	1–5 days	1 Rec.	4%.
61 Cases	"	6–10 days	20 "	33%.
44 Cases	"	10–20 days	11 "	25%.
6 Cases	"	over 20 days	3 "	50%.

I have collected and tabutated all the cases I could find in which antitoxine had been used. Many are lacking in detail; where possible I have quoted the opinion of the physician in charge as to the effect of the remedy employed. As in other departments of medicine it is probable that unfavorable results are not published, and Roux and Vaillard make this statement without, however, giving data or proof of the assertion.

Forty-four cases of tetanus are reported, one in a child after lying on the damp ground when much heated, one following a surgical operation, one in the puerperium, one after miscarriage, and forty following various injuries all of the extremities except two. Sixteen died, a mortality of 36%.

Further, I report seven cases of tetanus neonatorum, all fatal except one, and that one Escherich speaks of as chronic in which the prognosis could not be considered as grave at the worst.

Details are given in 27 cases that recovered:

Incubation, 5–10 days in 8 cases.
10–15 days in 10 cases.
15–20 days in 5 cases.
24 days in 2 cases.
38 days in 1 case.
42 days in 1 case.

In 24 cases with recovery, in which full clinical data are given:

4 were mild.
5 were severe.
7 were chronic.
8 were subacute.

In analysis of the cases with an incubation of 5–10 days, we find that in four cases the disease was mild in character, and existed except in one instance for seven days before the specific treatment was instituted. In cases 38 and 42 of short incubation, the disease was very mild, the first being the non-traumatic case which followed exposure.

Cases 22 and 23 were both acute, in that the symptoms were severe, the initial prognosis was bad, and the physicians in charge felt that the cure was dependent upon the use of antitoxine. In the cases with an incubation of 10–15 days, in four instances the disease lasted 11–19 days before the specific treatment was instituted; in the others an average of five days.

In case 3 the convulsions were severe, reaching 85 in a day; treatment was begun on the fifteenth day, and there was at first no appreciable effect from the injections.

In case 26 there was cyanosis, the spasms were severe, and the prognosis appeared bad; improvement followed the injections, and was apparently due to them.

In case 32 the incubation was 15 days, the prodromata were long, but the symptoms severe on the 10th day when specific treatment was begun; improvement followed the injections, was marked in 48 hours, and the cure was attributed to the injections.

In five cases the incubation was 15–20 days, in two cases 10 and 13 days respectively elapsed before treatment, and in the others an average of three days. None of the cases are described as severe.

In all the cases with an incubation period of 24 (two cases), 38 and 42 days respectively, the course was chronic, and no very marked effect was attributed to the treatment.

Through the kindness of Dr. Withington I had the pleasure of seeing case 44 (reported by him in detail in Boston Med. and Surg. Journal, 1896, p. 53). In my table I have put down the incubation as six days, with trismus on

the 13th day, as on the 6th day she first complained of difficulty in opening her mouth, at first supposed to be hysterical.

The prodromata were long, but the symptoms really terrific when the disease reached its height on the 19th day, and injections of Gibier's serum were used. Coincident with the treatment improvement began. I think that no one who had seen such a case could allow a patient to die of tetanus without giving him the benefit of a trial of antitoxine.

Such are the data from which we can form an opinion. The total mortality is considerably below the average for even chronic cases; the curative value of antitoxine is not proven either by experiments on animals or by clinical experience. From analogy we have no reason to fear serious effects from the use of the tetanus antitoxine. Taken all in all, we should give a patient with tetanus the benefit of the doubt, and use the remedy. It can never be cheap, as in the first place it is most difficult to make, leaving out of consideration the danger to the man who works with such a deadly poison, and secondly its use is limited as the disease is rare.

STREPTOCOCCUS INFECTION.

In the last year preliminary reports have been made as to the use of protective and curative serum in various diseases dependent upon infection with the streptococcus.

Marmorek, working under Roux and Metchnikoff at the Pasteur Institute, has published the most important work. His object was to obtain a curative serum. His attention was first directed to obtaining a medium that would preserve intact the virulence of a culture of the streptococci, or they soon become inert when cultivated in the ordinary laboratory media. His choice of media is as follows:

1. Human serum 2 parts, bouillon 1 part.
2. Ascitic fluid 1 part, bouillon 2 parts.

3. Serum of ass or mule 2 parts, bouillon 1 part.
4. Serum of horse 2 parts, bouillon 1 part.

These media preserve but do not increase the virulence of a culture.

Secondly, to render his animals immune to a degree sufficient to produce a curative serum, he wished to obtain cultures of great and definite virulence. Marmorek started with a culture from a case of false membrane in the throat, and by successive inoculation of rabbits obtained a culture of such virulence that an amount so minute as to contain but a single germ sufficed to kill a rabbit in a few hours. This dilution he speaks of as the "limite physique," as if more diluted it could not be used as one would not be likely to find even a single coccus in the amount injected.

Marmorek states that it is his opinion that the streptococcus formed in various pathological processes in man is one and the same, differing only in grade of virulence, and in proof thereof offers the experimental fact that streptococci from various processes and of varying grades of virulence may, by successive cultivation in the bodies of animals, all be brought to a point of virulence identical, all producing in animals an acute streptococcus septicæmia. Various biological characteristics he considers dependent on the media in which the organisms grow, and interchangeable with change of medium and condition of growth. Marmorek renders animals immune in practically the same manner as his predecessor in a similar line of work. In horses he begins with a small injection of a highly virulent culture, practically doubles the dose at each injection until at the end of six months from 600 c.c. to 1,000 c.c. are injected. The horse serum cannot be used for four weeks after the last injection.

Following the suggestion of Roux he rendered horses immune to diphtheria, immune to streptococcus infection, and found them less susceptible than horses not treated with diphtheria toxine.

Many diseases in man are caused by streptococci, or essential and important complications are dependent upon secondary infection with this germ. Erysipelas, various phlegmonous processes, throat diseases, broncho-pneumonia, the often severe complications of diphtheria, scarlet fever and pulmonary tuberculosis.

Marmorek reports numerous experiments upon man.

ERYSIPELAS.

Four hundred and thirteen cases. Mortality 3.87%. Previously 5%. Taking a series of 165 cases of erysipelas alone, without complications of other diseases, mortality 1.2%. As a result of the use of the serum Marmorek gives the following advantages:

Improvement in the general condition.
Fall of temperature.
Local improvement.

Dose 10 c.c. daily, or in very severe cases 20 c.c. Occasionally erythema follows the injection.

PUERPERAL FEVER.

Fifteen cases—

7.	Streptococcus infection alone,	Mort.	0.
3.	Strept. Inf. with colon bac.	"	3.
5.	Strept. Inf. with aureus.	"	2.

As an infection process may be a complex process, as seen in eight of these cases, the importance is shown of an exact bacteriological diagnosis in estimating the value of a treatment based upon specific curative measures.

PHLEGMONS.

Ten pure strept. In all rapid improvement.

Post operative infection in a case of vaginal hysterectomy with favorable results.

The compound serum from horses immunized against diphtheria and streptococcus infection is reported by Marmorek, and in use at the Hôpital aux Enfants Malades, with favorable results. He gives no details or statistics.

Denys and Leclef report the use of horse serum in various streptococcus diseases of man. Peritonitis following laparotomy, three cases, two rapid recoveries. Pyæmia, two cured quickly, one recovered ultimately. Gromakowsky independently of Marmorek made experiments with rabbits and succeeded in obtaining a curative and immunizing serum that he tried with benefit in two men.

April 10, 1896, at the meeting of the Obstretical Society of France, the treatment of puerperal septicæmia by serotherapy was discussed, and Charpentier reported forty cases collected from the practice of his colleagues. Mortality forty-two per cent. The general opinion was that the success was not brilliant, or at present such as to warrant much confidence, further that it was not proven as harmless.

SCARLET FEVER.

Marmorek has used antistreptococcic serum in scarlet fever. His reasons are that, though the etiological factor in scarlet fever is unknown, the severe complications as otitis purulenta, nephritis, endocarditis and pseudo-membranous angina are due to the streptococcus. Scarlet fever without these dangerous complications would not be a serious disease.

One hundred and three cases entered, seven were not treated. In ninety-six cases, a serum of 1–30,000 was used in doses of 10 c.c. In all the cases streptococci were found, seventeen were complicated with diphtheria, and were treated with the double serum, four being fatal. 10 c.c. serum were injected daily till the temperature fell, or if complications arose. The most marked effect was in cases with enlarged glands, nineteen cases without suppuration.

There was one case of mild otitis; four entered with otitis, but rapidly recovered.

"One or two injections sufficed to cure a nephritis if it appeared." Marmorek considers it of real advantage. No evil results. The mortality is not given. Baginsky made use of serum supplied by Marmorck and gives the following letter from Roux as to the serum: "Nothing authorizes you to consider that the serum has any efficacy in the scarlet fever itself; but a certain number of observations permit us to believe that it has a favorable influence on the complications due to the streptococcus, and so common in scarlet fever."

Baginsky treated forty-eight cases; several had enlarged glands which went on to suppuration. The mortality was 14%; previous mortality 22–30%. Baginsky in resumé merely says that the results were not more unfavorable than in previous years.

[Of 646 cases at the Boston City Hospital, the mortality was 63, or 9.4%.]

A serum from horses rendered immune to diphtheria and the streptococcus is advertised for sale at the Pasteur Institute in New York, made by Gibier. I have not seen reports as to its use.

TUBERCULOSIS.

As this disease is the arch enemy of man, we always look with hope towards a treatment which may help us to control its ravages. In considering any treatment, however, we must remember two factors: many cases recover under proper, general, hygienic treatment. The pathologist shows us that in from 20–25% of autopsies performed for diseases not associated with tuberculosis, we find evidence of a healed tuberculosis as demonstrated by cicatrices or cheesy deposits at the apices of the lungs, or cheesy

bronchial glands. Rienzi of Naples reports twenty-two cases treated by Maragliano's method.

1 c.c. serum every 2d day, for 10 days.
1 c.c. serum every day for 10 days.
2 c.c. serum every day for 10 days.

Rienzi divides his cases as follows: —

(a) 7 cases with circumscribed infiltration.
(b) 8 cases with diffuse signs, both lungs.
(c) 7 cases with advanced cavity formation.

In general, marked improvement in first class and a part of the second class, as evidenced by increased appetite, gain in weight, diminution of general disturbance, bacilli and amount of sputum. In 10 signs diminished, in 5 no change, and in 7 increased; the last all belonging to the third class. Other favorable cases have been reported by Italian observers.

Bernheim reports encouraging results, injecting 1-3 c.c. of serum from immunized animals; the treatment being continued for from three to six months. Paul Paquin reported at the American Medical Association experiments with serum based on similar principles. He used the blood serum of immunized horses. His reports are favorable; of twenty-two cases treated in an alms-house, all showed improvement, and none had died at the time of the report. In all a gain of 1½ to 22 lbs. Paquin believes the gain to be due to the specific effect of the serum used, in that the social and hygienic surroundings of the patients were not favorable to improvement on psychical or general hygienic principles.

Other observers have used injections of the serum of the ass or mule, animals which are practically immune to tuberculosis. In this regard it is worthy of note that experiments with the blood of hens, that are naturally immune to tetanus, have shown that their serum possesses no immunizing properties.

Maragliano himself reports 82 cases, and 119 treated by colleagues. On the whole favorable results.

Until some more definite results are reported, we must look upon this treatment with the eye of a sceptic.

MISCELLANEOUS DISEASES.

A few cases treated by sero-therapy are reported in many diseases, and I append a resumé.

TYPHUS.

In the province of Constatine typhus is endemic. In a prison at Bongie from November 25 to December 12, 40 cases occurred with 12 deaths. Sero-therapy was commenced December 12, the material used being serum obtained from two patients who had convalesced from a severe type of the disease. From 2 to 6 c.c. were injected into each of the following 39 cases, and only one died. Legrain noted, fall of temperature, improvement in the pulse, disappearance of coma and that severe cases soon became mild in type.

TYPHOID FEVER.

Beumer and Peiper rendered sheep immune to inoculation with the typhoid bacillus; the blood of these sheep rendered experimental animals immune to the action of the typhoid baccillus. As animals do not have typhoid fever the author can only claim that they can prevent or cure a form of septicæmia in animals produced by the typhoid bacillus. Börgen has used the serum of B. P. in 12 cases of typhoid in man, but without apparent results.

Several men have employed the serum of patients convalescent from typhoid, but without results worth mentioning.

CEREBRO-SPINAL MENINGITIS.

Righi reports the case of a boy seven years old who had cerebro-spinal meningitis a few weeks after his sister had recovered from the disease. The symptoms were headache,

chills, fever, vomiting, and on the second day there was stiffness of the neck. In a few days strabismus, facial paralysis and coma followed. On the sixth day blood was drawn from his sister's arm and 5 c.c. of the serum were injected into the boy. Marked improvement followed in a few days, so that he sat up. After a few hours he took food. In fifteen days he was well, except for a slight facial paralysis.

RABIES.

Tizzoni and Centanni report that the serum of animals rendered immune to hydrophobia has the power of conferring immunity and arresting the disease already developed.

The dose required for therapeutic purposes is larger than the dose necessary to produce immunity; but whereas in tetanus a dose for therapeutic purposes is 1000 times that needed to produce immunity, in hydrophobia it is only ten times larger.

So far no trial has been made in rabies in man; if successful its value will surpass the treatment of Pasteur in that the latter may produce immunity, but cannot cure the disease if once developed.

LEPROSY.

A vague rumor, without details as to methods, comes from South America that Carrasquila has had favorable results in the treatment of leprosy, 15 cases, by serum. As the germs of leprosy cannot be cultivated and no animals have leprosy, further that so far as we know the disease is incurable (many cases recover spontaneously—*H.C.E.*), but little credence can be given to the report.

Such in brief are the main facts and theories as to serotherapy as applied to diseases other than diphtheria. As we seem to have control of one disease so we may hope for success in others, but we should always remember the old saying that it is "the wisest physician who knows when to withhold treatment and await events."

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Righi. Wien. Med. Presse. 1895. p. 1796.

CASES OF TETANUS TREATED BY SERO-THERAPY.

Cases and References.	*Period of Incubation.*	*Day when Treatment was begun.*	*Character of the Disease.*	*Treatment used.*	*Remarks by Physician in charge of the Case.*	*Result.*
1.—Man, 45. Gagliardi. Cent. f. Bact. xii., p. 115.	12 days.	11 days.	Typical Tet. Severe.	Four doses .25 Tizz. Ant.	Improvement after 5th day Treat.	Rec.
2.—Boy, 15. Schwarz. Cent. f. Bact. x., p. 785.	14 days.	14 days.	Moderately severe subacute Tet.	Four doses Tizz. Ant. .15, 15 & 2 of .25.	Improvement after 4th day.	Rec.
3.—Man, 21. Pacini. Cent. f. Bact. xi., p. 423.	10 days.	15 days.	Severe. 85 convulsions in a day.	.25 Tizz. Ant. twice a day for seven days.	Treatment omitted after 7th day.	Rec.
4.— Finotti. Wiener Kl. W. 1892, p. 1.	10 days.	4 days.		Tizz. Ant.		Rec.
5.— Tizzoni. Cent. f. Bact. xii., p. 801.	12 days.	2 days.	No details.	40 c.c. Serum. 1.35 g. of Tizzoni.		Rec.
6.—Man. 74. Taruffi. Cent. f. Bact. xi., p. 625.	10 days.	3 days.	Not severe case.	5 doses of .25 Tizz. Ant.	Favorable action after first injection.	Rec.
7.—Woman, 22. Casali. Cent. f. Bact. xii., p. 56.	8 days.	7 days.	Not severe.	5 doses of .25 Tizz. Ant.	No increase of symptoms, and gradual improvement from first injection.	Rec.
8.— Finotti. Cent. f. Bact. xii., p. 801.	15 days.	1 day.		Tizz. Ant. in all 4.80 gm.	No details.	Rec.
9.— Magagni. Cent. f. Bact. xiv., p. 157.	8 days.	3 days.	Subacute.	11 doses of .25 Tizz. Ant.	No details.	Cure.
10.—Woman, 19. Finotti. Cent. f. Bact. xiv., p. 157.	24 days.	5 days.	Subacute.	11 doses of .25 Tizz. Ant.	No details.	Cure.
11.— Rotter. Behring's book. "Tetanus Heilserum."	15 days.	7 days.	Chronic.	Behring's Serum.	Doubtful as to effect of Serum.	Rec.

Cases and References.	Period of Incubation.	Day when Treatment was begun.	Character of the Disease.	Treatment used.	Remarks by Physician in charge of the Case.	Result.
12, 13.—Renon. Ann. de l'Institut. Pasteur, 1892, p. 233.				Serum of Roux and Vaillard.	No details.	Both fatal.
14.—Boy, 9. Buschke & Œrgel. D. Med. Woch. 1893, p. 149.	9 days.	12 hours.	Very acute and severe.	10 c.c. Behring's Serum.	Death 1½ hours after injection.	Fatal.
15–21.—Roux & Vaillard. Ann. de l'Institut. Pasteur. 1893. No. 2.	1. 15 days.	4 days.		In all five a curative Serum of great activity made by Roux and Vaillard.		Fatal.
	2. 8 days.	4 days.				"
	3. 5 days.	36 hours.				"
	4. 8 days.	36 hours.				"
	5. 14 days.	2 days.				"
	6. 15 days.	3 days.	Chronic.	Same.	Never severely sick. R. & V. report no effect from Serum.	Rec.
	7. 4 days.	7 days.	Chronic.			
22.—Girl, 15. Gattai. Cent. f. Bact. xiv., p. 108.	5 days.	4 days.	Acute. Rapid increase of symptoms.	Tizz. Ant. 9 doses .50 Cent. & 3 occ. Ser.	Bad prognosis. Cure due to treatment.	Cure.
23.—Man, 19. Lesi. Cent. f. Bact. xiv., p. 393.	6 days.	24 hours.	Acute & severe.	Tizz. Horse Serum. 1–10,000,000.	Marked improvement & rapid recovery after injections.	Rec.
24–25.—Remesoff & Federoff.	10 days.	6 days.	Moderately severe.	Serum of dog.	Improvement after injection, & cure probably due to Serum.	Cure.
	Indef.	3 days.	Subacute.	Serum of dog.	Improvement, but death from Pneumonia.	Fatal.
26.—Child, 4½. Tirard. Lancet, 1895, p. 1101.	14 days.	4 days.	Severe spasms.	5 doses of 10 grains Antitoxine.	Improvement after injection. Prognosis bad.	Rec.
27.—Man, 28. Marriott. Brit. Med. Jour. 1895, p. 132.	6 days.	6 days.	Subacute.	7.5 gm. Antitoxine.	Improved by Ant.	Rec.
28.—Boy, 16. Dean. Brit. Med. Jour. 1894, p. 579.	24 days.	5 days.	Chronic in course.	12 gm. Antitoxine. Tizzoni.	"In doubt as to the effect of the Antitoxine."	Rec.
29.—Boy, 13. Evans. Brit. Med. Jour. 1894, p. 581.	38 days.	10 days.	Chronic.	2.25 gm. Antitoxine. Tizzoni.	Mild case.	Rec.

Cases and References.	Period of Incubation.	Day when Treatment was begun.	Character of the Disease.	Treatment used.	Remarks by Physician in charge of the case.	Result.
30–31.—Man, 22. Hacker. Berl. Kl. Woch. 1894, p. 661.	14 days.	1 day.	Severe, but chronic course.	4.50 gm. Tizzoni.	Prompt relief from remedy.	Cure.
	6 wks.		Chronic.			Cure.
32.—Man, 22. Giusti & Bonaniti. Berl. Kl. W. 1894, p. 818.	15 days.	10 days.	Severe case, but long prodromata.	Tizz. 60 c.c. horse serum. 110 c.c. dog serum. 2 gm. Antitoxine.	Improvement from first, and marked in 48 hours. Cure due to Serum.	Cure.
33.—Man, 28. Marson. Lancet, 1895, p. 329.	10 days.	6 days.	Subacute.	2 gm. Tizz. Antitoxine.	Gradual improvement in Tetanic symptoms. Death from Septic.	Fatal.
34.—Woman, 31. Walko. Cent. f. Bact. xviii., p. 601.	9 days.	5 days.	Puerperal case.	Tizz. Ant. 18 doses of .20.	No change.	Fatal.
35–37.—Woman. Macartney. Lancet, 1896, p. 157.	7 days.	7 days.	Severe. Followed operation.	1 dose Antitoxine.	Death one hour later. (Remedy used late.)	Fatal.
	7 days.	1 day.	Very severe.	2 doses Antitoxine.	Death within 24 hours of symptoms.	Fatal.
Boy, 5.	4 days.	At once.	Very severe.	1 dose.	Death in few hours.	Fatal.
38.—Girl, 11. Dörfler. Munch. Med. W. 1894, p. 282.	2 days.	9 days.	Mild. Non-traumatic case.	50 c.c. Behring's Serum.	Good prognosis. Followed exposure to cold when much heated.	Cure.
39.—Boy, 13. Thompson. N. Y. Med. Rec. 1895, p. 5.	19 days.	13 days.	Chronic.	Small doses of Toxin (Brieger).	T. says first case treated in New York.	Cure.
40.—Man, 28. Bauer. Wiener Kl. W. 1894, p. 846.	9 days.	1 day.	Severe convulsion.	1 dose Antitoxine.	Very severe.	Fatal.
41.—Man, 41. Schwarz. Wiener Med. W. 1894, Nos. 49–52.		2 days.	Severe convulsion.	Tizz. Ant.	Death in 4 days. No change.	Fatal.
42.—Woman, 44. Caretti. Cent. f. Bact. xvii., p. 538.	8 days.	At once.	Mild.	4 doses of 2.25 Tizz. Ant.	No further symptoms, and discharged well in 5 weeks.	Cure.
43.—Sahli. Cent. für Bact. xviii., p. 761.		No details.		Tizz. Ant.	Attributed cure to Ant.	Cure.
44.—Woman. Withington. Bost. Med & Sur. Jour. 1896, p. 53.	6 days, trismus 13 days after miscarriage.	19 days.	Long prodromata convulsion, severe and numerous.	Gibier Serum.	Gradual improvement after injection. Prog. seemed very grave.	Rec.

TETANUS NEONATORUM.

Cases and References.	*Period of Incubation.*	*Day when Treatment was begun.*	*Character of the Disease.*	*Treatment used.*	*Remarks by Physician in charge of the Case.*	*Result.*
Escherich. Wiener Kl. W. 1893, p. 586. Four cases.	9 days old.	3d day.		Tizz. Ant.	Death in 12 hours. Pneumonia.	Fatal.
	12 days old.	3d day.		" "	Death in 3 days. Pneumonia.	Fatal.
	4 days old.	1st day.		" "	Death in 24 hours. Peritonitis.	Fatal.
	13 days old.	3d day.	Chronic.	" "	Apparently a case with good prog. from first.	Rec.
Frith. Brit. Med. Jour. 1895, p. 133.	15 days old.	2d day.	Acute.	.4 Ant.	No improvement.	Fatal.
2 cases. Papiewski. Jahrbuch f. Kinderheilkunde xxxvii., heft. 1.	9 days old.	2 days.		Tizz. Ant.	Death in 3 days.	Both fatal.
	8 days old.	2 days.		" "	Death in 5 days.	

ARTICLE X.

THE TREATMENT OF COLD ABSCESSES.

By HOMER GAGE, M.D.
OF WORCESTER.

READ JUNE 9, 1896.

TREATMENT OF COLD ABSCESSES.

In considering thus briefly the Treatment of Cold Abscesses, I have limited myself to those which occur in connection with tubercular disease of the bones and joints, omitting all reference to the glandular and other varieties. What to do with these abscesses has long been the subject of much controversy — on the one side the true orthopedist, with his cautious conservatism, urging that they be left largely to nature, and on the other the general surgeon, with his stern adherence to the old dictum that pus must be removed whenever found, urging the policy of active interference. There has been much discussion but there is a very noticeable absence of any definite statistical information, especially from those who believe in leaving these abscesses to nature; and the controversy seems likely to continue as an expression of individual experience, opinion and prejudice.

One thing has, however, been made plain to us all and should be recognized as settled beyond dispute, viz., that the abscess is always secondary in importance, as well as in development, to the primary lesion, whether that is situated in the bone or in the joint. And it follows from this, that whatever methods are to be adopted in dealing with these secondary complications, they must be such as will interfere as little as possible with the treatment of the primary disease. This is, I think, the fundamental principle underlying this whole discussion, from whichever side

it is viewed. The presence of pus diminishes somewhat the chance of an ideal result. There is a little more liability to ultimate deformity and limitation of motion; but this is very much less than was formerly supposed, and will be still less in proportion as the abscess is prevented from interfering with the continuance of effective mechanical treatment.

The possibility of a spontaneous disappearance of a cold abscess by inspissation and absorption is now nowhere disputed. Many cases have been reported by Judson, Ridlon, Schaffer, Gibney and others. I have myself seen one psoas abscess and one abscess in connection with tubercular disease of the hip entirely and permanently disappear. Such instances are, however, relatively very few,—far too few to be held out as an inducement never to interfere, unless it can be shown that by letting them alone we in no wise increase the difficulties or dangers of their subsequent management, in case they are not absorbed.

There are, moreover, many cases in which pain, loss of appetite, anæmia, or other constitutional disturbance seem to be dependent upon the presence of an abscess, where interference seems imperative, as it does also where the location of an abscess would prevent the use of suitable apparatus. Such cases cease at once to be the subject of controversy. The debatable ground is that occupied by those whose development is unaccompanied by any constitutional disturbance or by any interference with the continued use of mechanical support. Are they to be opened as soon as recognized, or should they be allowed to remain until they are ready to discharge spontaneously?

When pus has escaped into the inter-muscular spaces about the bone or joint in which it has originated, the abscess tends to increase slowly, but steadily, in the direction favored by gravity. Even after fluctuation has become quite superficial it may continue to spread for weeks or

even months before spontaneous rupture takes place. It is liable all the while to secondary infection through the skin by more active pus-producing bacteria; its spontaneous opening is more likely to be so situated as to provide insufficient drainage, and the larger the abscess cavity, all of which is lined with a tuberculous membrane, the longer time will be required to heal it, with at least an equal chance of general or systemic infection. These reasons are, I think, sufficient to prevent us from allowing even those abscesses which do not give rise to any constitutional disturbance or interfere with mechanical treatment, always to pursue their natural course. If, however, it is admitted, as I think it should be, that the chance of septic infection of the sinus or abscess cavity is as great after a natural as after an artificial opening, and that the length of time during which the discharge will continue depends upon the condition of the bone or joint from whence it comes rather than upon the manner in which it has escaped through the skin; if this be admitted, and I do not see how it can be denied, there is no advantage to be gained from leaving any of these abscesses alone, except those which may spontaneously disappear. Can we distinguish these beforehand?

In two cases of abscess complicating tubercular disease of the hip recently operated upon by me, cultures and cover-slip preparations were taken from each. In the first, the culture tubes were sterile, while the cover-slips showed the presence of tubercle bacilli; in the second, the culture tubes revealed the staphylococcus albus and citreus, while the cover slips were negative. It is, I think, unusual, even in undoubted tubercular cases, to be able to demonstrate the presence of the bacilli; but even when they cannot be found and the cultures are sterile, inoculation experiments prove the tubercular character of the pus. There are, then, as typified in these two cases, two distinct sorts

of pus occurring in connection with bone and joint tuberculosis, namely: That which arises from the tubercle bacillus alone, and that which is due to a mixed infection from the simultaneous presence of the tubercle bacillus and other pyogenic cocci. When a mixed infection is present, even if there are no evidences of constitutional impairment, it is exceedingly unlikely that spontaneous resolution will ever occur. Those abscesses which disappear after one or more aspirations are, as a rule, instances of pure tubercular infection, and it is probable that such is also the character of those which disappear of themselves. If, then, we could distinguish beforehand the cases of pure tubercular infection from the mixed infections, we should have reasonable grounds for leaving the first to nature, so long as their growth was not excessive and until they threatened to open spontaneously, and for operating always on the second. Can we make this distinction? In this connection I am under great obligation to Dr. Richard C. Cabot for permission to refer to an unpublished article by Dr. John Dane, bearing upon the relation of leucocytosis to tubercular inflammations. Dr. Dane has shown bacteriologically, and the work is confirmed by Dr. Cabot clinically, that "in pure tubercular abscess, as in all purely tubercular lesions, leucocytosis is absent. If at any time the infection becomes a mixed one through the advent of pus cocci, leucocytosis occurs. For instance, many cold abscesses of rib, hip, vertebra, etc., show no leucocytosis till opened, then the white cells rise." If these observations shall be confirmed by further investigation, I think it fair to assume that active interference should be postponed so long as leucocytosis is absent. For the same reason, those cases in which cultures obtained by aspiration remain sterile, may profitably be left to themselves. The presence of leucocytosis or of colonies of pus cocci in our cultures is an indication for active interference. When should the opening be made?

We are speaking now not of the cases in which the patient's general condition or the proper management of his bone or joint leison are affected by the presence of the abscess. These should be operated upon as soon as such interference is recognized. Where there is no snch interference, I think the opening may be advantageously delayed until the abscess has become quite superficial,— such a course will allow the opening to be made more easily, accurately, and with less dissection through healthy or uninfected tissues. I should favor interference rather than waiting for spontaneous opening, because I can control the point of drainage, prevent the unnecessary extension of the tubercular process, and the better control the chance of infection from without.

What of the methods of interference? Many have been suggested, of which the most important are: Aspiration; aspiration with irrigation, and iodoform injections; simple incision; and free incision, with curettage. Aspiration has never seemed to me a scientific procedure, except when undertaken merely for exploratory purposes, and in my hands has simply resulted in an ultimate sinus at the point of insertion of the needle. Aspiration, with irrigation and the injection of iodoform, was a few years since heralded as a specific for these local tubercular leisons. Most encouraging reports came to us from Billroth, Mikulicz, Bruns, and von Moorhof. The method has, however, never yielded such brilliant results in this country, and, although enthusiastically championed by Senn, has never found favor in our true orthopedic clinics. The real issue lies, I think, between simple incision and free incision with curettage. The latter aims to remove all the tubercular product, and secure, as near as possible, primary union. Its advocates seem to overlook the source from which the pus started, and from which it will continue to come, until it is itself exhausted. In too many of these cases the primary union

is gained but for a short time, only until the sinus leading directly to the original disease can be re-established. It is forgotten that the abscess is but a secondary consideration — the original disease of the bone or joint the primary and all-important one; and that the length of time during which suppuration will continue depends almost entirely upon the condition of the original leison, and has comparatively little to do with the method by which the abscess is treated.

It is not at all uncommon, when an abscess opens spontaneously at its most dependent part before it has become very large, and when it has not been in any way interfered with, for us to see early, spontaneous healing and gratifying results, so far as the restoration of function is concerned.

While I believe that the situation of the drain and the limitation of the growth of the abscess make the artificial opening the better one, I think we can learn much from nature's own method. I was very much impressed, when house officer at the Boston Children's Hospital, with a series of cases treated by Dr. A. T. Cabot with a small opening made in the most favorable place and without any interference with abscess cavity by irrigation or curette. I have since occasionally practised the same method myself, and I believe that it approaches more nearly the natural one, causes less constitutional disturbance, and is less likely to result in constitutional infection, than other more radical measures; and when undertaken with strict precautions to prevent infection from without, seems to me to be the most desirable method of treatment.

Resumé:

1st. An abscess occurring in connection with tubercular disease of the bones or joints is always secondary in importance, as well as in development, to the primary disease.

It treatment must not, therefore, in any way interfere with the treatment of the original lesion.

2d. When the abscess is accompanied by any evidences of constitutional impairment, or interferes in any way by its location with the use of proper mechanical treatment, it should be immediately opened. When there is no interference with general health or with mechanical treatment, the abscess, if it presents a pure tubercular infection, may be left until it is nearly ready to open spontaneously. If it presents a mixed infection, it is to be opened at once.

3d. All cases are to be opened as soon as they approach the surface, to avoid unnecessarily extensive burrowing.

4th. Of the methods commonly used in opening these abscesses, aspiration with irrigation, free incision with curetting, all seem to give inferior results to those obtained by simple incision in most dependent portion, with the least possible interference with the walls of the abscess.

ARTICLE XI.

THE CLINICAL USES OF THE PREPARATIONS FROM THE THYROID GLAND, PITUITARY BODY, SUPRARENAL CAPSULES AND BONE MARROW.

By RICHARD C. CABOT, M.D.
OF BOSTON.

READ JUNE 9, 1896.

THE CLINICAL USES OF THE PREPARATIONS FROM THE THYROID GLAND, PITUITARY BODY, SUPRARENAL CAPSULES AND BONE MARROW.

To cover the ground with reasonable thoroughness I have had to limit myself in two directions.

First, I have kept strictly to the title of my paper, and studied only the *clinical uses* of these preparations and not the theory of their nature, the modes of their preparation or action, nor the history of their introduction into medicine.

Secondly, I have thought it best to say nothing at all of the use of the preparations of the thyroid gland in myxœdema, sporadic and endemic cretinism and cachexia strumipriva. The usefulness of thyroid extract in these conditions is now so well established that any discussion of it would be tedious. Therefore, in speaking of the thyroid extract I shall confine myself to its uses in conditions other than those just mentioned.

THYROID EXTRACT.

Besides myxœdema, cretenism and cachexia following thyroid extirpation, there is a long list of diseased con-

ditions in which thyroid extract has been used, the most important of which are: —

1. Simple goitre.
2. Exophthalmic goitre or Graves' disease.
3. Obesity.
4. Psoriasis and other cutaneous diseases, including alopecia.
5. Tetany.
6. Insanity and various psychoses.
7. Retarded development in children.
8. Chlorosis.

The thread that binds all these apparently heterogenous conditions together is the fact that they all are or may be associated with myxœdema, and when so associated have been cured or ameliorated by the thyroid treatment.

Thus some myxœdematous patients are goitrous, many are fat and suffer from various cutaneous disorders; mental troubles are a very frequent symptom, and retarded development not uncommon. Many myxœdematous patients get very anæmic, and some, especially those whose myxœdema is due to removal of the thyroid, show the spasms of tetany.

Hence, it has occurred to physicians to use the thyroid treatment in each of these conditions when occurring *without* myxœdema.

Further, thyroid preparations have been used in *rickets*, probably from a general sense of its value in diseases of nutrition, and perhaps the same idea may have led to its use in *diabetes* and *gout*. It has been used in *fibroid tumors of the uterus* and for *hypertrophied scars* — its marked powers of tissue metamorphosis probably recommending it.

Favorable reports of its use in lupus led to its use in phthisis; and finally syphilis, cancer and leprosy have been experimented on. It is said to be good for piles.

I will take up these various uses of the thyroid extract in what seems to be the order of their importance.

THYROID EXTRACT FOR SIMPLE GOITRE.

Relief is sought in these cases either on account of the disfigurement and inconvenience of the tumor, or because of the pressure symptoms which it causes. Without treatment, tracheotomy is sometimes necessary to relieve the distress of breathing.[19] (See table I.). Out of a total of 322 published cases, 279 or 87% are set down as improved, and only 43 as not improved.

The statistics are large enough to be convincing, I think, of the great value of thyroid extract in simple parenchymatous goitre. There have been, so far as I can ascertain, no wholly unfavorable reports — none where marked improvement has not appeared in a majority of all cases in which any one observer has tried it. Those who have tried the remedy in large numbers of cases agree that it is most effective in goitres *that are of recent appearance and of moderate* size, and especially in those occurring in young people.*

Failures are mostly — (1) In cystic or colloid goitre. (2) In middle-aged people who have had a tumor a long time. It seems safe to say that every parenchymatous goitre of recent appearance in a young person can be considerably *diminished* by thyroid feeding. It is uncommon to see the tumor wholly disappear, only about 10% of the cases having so resulted, but often there remain only a few hard nodules not previously felt which can be easily dissected out.

Some of the cases show distinct diminution in the size of the goitre after four or five days treatment, and in several the tumor was entirely gone within a month. After six to ten weeks' treatment the diminution has usually reached its limit, but some continue to improve for a longer period, and occasionally it is six weeks before any improvement begins.

* The younger the better. Thomas[14] reports splendid results in sucklings with congenital goitre.

TABLE NO. I.—THYROID FEEDING IN GOITRE.

Author.	*No. of Cases.*	*Cured.*	*Improved.*	*Not Improved.*	*Remarks.*
Bruns (1),	60	14	29	17	Used the raw gland itself. "Thyroidism" in 1 case only. 3 relapsed after treatment. Admitted failures—(a) cystic or colloid goitres; (b) adult patients with tumors of long standing.
Kocher (2),	7	0	5	2	The failures were, one a goitre and the other a colloid tumor.
Séné (3),	1	0	1	0	
Alexjew (4),	2	1	1	0	
Epelbaum (5),	1	0	1	0	
Ingals & Ohls (6),*	50	2	35	11	1 case not heard from. 2 of those not improved were under treatment less than a week. Cystic tumors were not excluded.
Knöpfelmacher (7),	22	(12†)	5	5	The 5 obstinate cases were also unaffected by the iodine treatment, by ointment and internally.
Marie (8),	1	0	1	0	Showed diminution in size within 5 days.
Reinhold (9),	12	0	12	0	Insane patients.—7 lost an average of 4 lbs. in weight in 6 weeks. 2 gained weight (3-9 lbs.). No change in mental symptoms.
Angerer (10),	78	0	72	6	Those not improved gave up treatment on account of "thyroidism"; most lost weight (6 lbs. in 5 weeks—average), but gained it back later. 2 relapses 5 and 7 months after omission of treatment. Prefers the raw gland.
Stabel (11),	60	4	56	0	26 cases on raw gland did much better than 34 on tablets: no "thyroidism."
Ewald (12),	19	0	19	0	Used English tablets, and finds them much better than German.
Putnam (13),	3	0	?	1	2 not heard from.
Thomas (14),	?	?	All	0	"Splendid results."—All in young infants.
Hennig (15),	2	0	1	1	Using "Thyrojodin" [Baumann (18)].
Eschler (16),	"Many"	"Many"	?	?	Does best in young people.
Sänger (17),	1	0	1	0	

* Including cases reported in letters to the author. † Nearly.

Relapses. — As most of the statistics are within a year, our knowledge as to the permanency of the cures is obviously very limited. Nine months after the cessation of treatment, many of the cases have shown no relapse. On the other hand, Bruns [1] finds three-fourths of his sixty cases begin to relapse three months after cessation of treatment. The statements of observers are not sufficiently full on this point in most cases, and we cannot say at present how frequently the marked improvements above recorded are destined to be permanent, and whether, as in myxœdema, we must maintain the thyroid treatment through life to prevent relapse.

Those cases which disappear most rapidly under thyroid treatment have shown, according to Stabel,[11] the greatest tendency to early relapse. Slight loss of weight during the treatment is the rule, averaging five to six pounds in Angerer's [10] seventy-eight cases. Severe toxic symptoms are rare and can be prevented by care. (Vide infra.)

THYROID TREATMENT IN OBESITY.

The vast majority of observers are agreed that most obese persons, and many who are not so, lose weight rapidly during the first week of treatment with thyroid extract, *the diet being unrestricted*. We can tell to a certain extent what type of obesity is most likely to be benefited.

Leichtenstern[48], Buquin[47], Kraus[49], and others, have noticed that in young, robust and vigorous but obese persons, the treatment is not effective.

It is especially successful where obesity is associated with pallor and flabby, doughy tissues, reminding one of œdema and faintly of myxœdema, and as such a condition is commoner in women, the remedy more often works well in women than in men. The loss of weight is most rapid during the first week of treatment, but continues more slowly for months in some cases.

Among the most striking cases are those of J. J. Putnam[30] who was the first, so far as I can ascertain, to use thyroid extract in simple obesity. One of his cases lost forty-seven pounds under thyroid treatment. Ratgen[35] reports a loss of fifty-seven pounds in three months' treatment. Rendu's[21] case lost sixty-six pounds in two months with no relapse up to date (one year). A loss of a pound a day for the first week is not at all uncommon.

In most cases this loss of weight represents not simply a loss of fat (and water) from the tissues, but a drain on the lean as well. The excreta show that an increased amount of albumenoid matter is being burnt up in the body, so that muscle as well as fat is lost. V. Noorden[25] says that thyroid extract is the only known drug that increases the process of oxidation in the body without muscular or glandular exercise. He compares it to a blast from "a pair of bellows rousing the smouldering fire of metabolism to fiercer flames." But as regard the albumenoids of the body this is just what we want to avoid in our treatment of obesity, and in fact it can be avoided if a diet is so arranged that the loss of albumenoids is compensated by an increase in the proteid elements of the diet. (Ewald[44].)

Relapse.—The majority of observers agree that the weight is soon regained after the remedy is left off, unless exercise or careful dieting prevents it.

This relapse does not always occur (Rendu. loc. cit.) and is often delayed some weeks or even months after the remedy is omitted, but in a larger number of cases the weight begins to increase again very quickly and not infrequently reaches its former figure within a month. Cases are recorded where patients have actually gained weight during the use of the remedy, but this is very rare. (Bournville[38], Ingals[26], MeKenzie[27].)

At the Congress for Internal Medicine held at Wiesbaden just two months ago to-day, Ewald sums up a discus-

sion on this topic with the conclusion that we have in thyroid feeding a precious remedy in cases of obesity, and one whose ill effects can all be avoided. He recommends that we should never give this treatment to any patient whom we cannot watch closely, for its dangers, if not carefully watched, are considerable[61]. (The danger signals will be briefly considered later on.) In some cases, he says, the remedy entirely fails, the tendency of the organism to conserve its fat being very strong. Ewald compares such cases to those of pernicious anæmia where the preservation of the fat layer up to death is so striking.

Drs. H. C. Baldwin and Harold Williams, of Boston, have been good enough to let me mention the results of their experience in the thyroid treatment of obesity. Dr. Baldwin's *three* cases showed marked loss of weight, but relapsed because exercise was not kept up after the remedy was omitted. Some of Dr. Williams's *seven* cases have not relapsed, and have been in all respects successful. In two an associated acne rosacea improved much during the treatment. (See Table II.)

Out of a total of 145 cases which I have been able to collect, all but six got thinner under the treatment, so that except for the question of relapse the treatment was successful in over 96% of the recorded cases. How often and for how long relapse can be prevented, either by continuing the thyroid treatment, by exercise, by diet, or by a combination of these measures, we are not yet in a position to know. The remedy is still too new.

THYROID FEEDING IN SKIN DISEASES.

Here the results have been markedly poorer than in goitre and obesity. The remedy has been tried to a limited extent in a variety of diseases affecting the skin, but especially in psoriasis. (See Table III.)

Table II.

THYROID TREATMENT OF OBESITY.

Author.	*No. of Cases.*	*Loss of Weight.*	*Duration of Treatment.*	*Not Improved.*	*Relapse.*	*Remarks.*
Leichtenstern & Wendelstadt (20),	27	3–19 lbs.	4–6 weeks.	2	?	Anæmic, flabby cases do best.
Rendu (21),	2	66 lbs. in one; "marvelous" in the other.	2 months.	0	None so far (1 year).	Used tablets of dried extract.
Dennig (22),	5	6 lbs. average.	10–27 days.	1	1	Some show increase of albumen-excretion; others do not.
Buquin (23),	3					
——* (24),	3	9 lbs. 16 " ? "	3 weeks.			
V. Noorden (25),	17	"Considerable."	?	?	"Most."	Finds it useless unless supplemented by diet, but helps some where diet alone fails.
Ingals (26),	2	5 lbs. in one.	?	1	?	One case gained 5 lbs. under treatment.
McKenzie (27),	1	8½ lbs.	1 month.	0	Yes.	Gained back 5 lbs. while still taking thyroid.
Smith (28),	1	"Considerable."	?	0	?	
Schlesinger (29),	1	"Very successful."				Tablets of beef thyroid had no effect.

* Letter to Münch. Med. Woch., April 23, 1895.

Jerzykowski (30),	10	"Considerable."	?	?	?	Effective only when combined with diet. Used Merck's tablets.
Putnam (31),	6	40 lbs. in one. 47 " " "			Yes.	Relapsed when thyroid was omitted. Other cases lost no weight.
Bleibtreu (32),	1	6¼ lbs.	?	0	?	Lost albuminoids spite of increased protein diet.
Meltzer (33),	1	?	?	0	?	Began to improve in 24 hours.
Buschan (34),	1	"Much."	?	0	?	
Ratjen (35),	1	57 lbs.	3 months.	0	?	
Barron (36),	5	One lost 28 lbs., others less.	6 weeks.	0	?	
Becker (37),	2	7 and 10 lbs.	1 week.		Yes.	
Bournville (38),	6	4, 5, 6, 8 and 12 lbs.	8–10 weeks.	1	Yes.	Idiotic children—all relapsed. Some *during* treatment.
Davies (39),	1	"Considerable."	?	0	?	In this case diet alone was useless, but with thyroids too was very efficacious.
Williams (40),	7	"Considerable," 36 in one.	?	1	0	Acne rosacea in two; markedly improved.
Baldwin (41),	3	One lost 40 lbs. " " 10 " One lost several lbs.	?	0	3	Weight regained, because active exercise not kept up after stopping thyroid extract.
Grawitz (42),	2	6 lbs.	1 & 3 weeks.	0	?	Using "thyrojodin."
Hennig (43),	24	2–10 lbs. per week.	?	0	?	Using "thyrojodin." One lost 20 lbs. in twenty-three days.
Ewald (44),	11	8–10 lbs.	6 weeks.	1	"Most."	Using "thyrojodin."
Eulenburg (45),	1	17 lbs.	?	?	?	
Magnus-Levy (46),	1	8 lbs.				
Total.....	145					

TABLE III.—THYROID TREATMENT OF PSORIASIS.

Author.	*No. of Cases.*	*Improved.*	*Not Improved.*	*Worse.*	*Relapse.*	*Remarks.*
Abraham (52),	65	18 (11 had local treatment too).	16	15	?	In 11, treatment had not continued long enough to judge of its results.
Thibierge (53),	11	8	3	0	?	Average loss of w'gt 12 lbs. in 6 w'ks. Those who improved had local treatment also.
Crary (54),	9	2	7	0	?	Noticed peculiar "meaty" odor to skin.
Busch (55),	24	18	6	0	.?	11 "cured."
Bramwell (56),	6	3	3		0	1 very stubborn case cured in few weeks without local treatment; 2 are "well" (6 mos., no relapse).
Squire (57),	2	0	2			
Dill (58),	4	3	0	1		1 "cured."
Davies (59),	2	2	0	0	?	
Hyde (60),	10	0	10			
Eschle (61),	2	2	0			Fresh cases in young people.
Brooks (62),	5	0	1	4		
Phillips (63),	2	0	2			
Putnam (64),	1	0	1			
Preese (65),	1	1	0	0	?	20 years standing. Resisted all kinds of treatment hitherto. "Cured."
Wilson (66),	1	1				Cured-hair reappeared on scalp.
Unna (67),	1	0	1			
Auld (68),	1	1	0	0	?	Stubborn; hitherto "cured" in 1 week. 1 tablet daily (Burroughs & Welcome).
Mosse (69),	1	1	0		?	Stubborn case, 1 year's standing. Prompt "cure."
Jones (70),	1	0	0	1		Glycosuria during treatment.
Tschernogurow (71),	1	1	0	0	?	"Cured."
Anderson (72),	1	0	1	0	?	
Gordon (73),	1	1	0	0	?	
Combe (74),	?	Yes.		0		
Epelbaum (75),	1	1	0			
Total.....	154	63		22		

Out of 153 cases, only sixty-two improved during treatment, and of these only forty-three had thyroid treatment without local remedies as well, so that only about one fourth of the cases can be said to be really improved by the thyroid. Further, as the records of these cases are all very recent, and as very little is said as to the presence or absence of relapses, we may well hesitate to believe that the results are really due to the treatment and not to one of the spontaneous ameliorations so common in the course of the disease.

Those most sanguine as to the merits of thyroid extract for psoriasis admit that there are many cases in which it has no effect and that some (about $\frac{1}{6}$) are made worse by it. Byrom Bramwell[56] thinks it a specific for certain types of the disease, but he has never attempted to point out any means of knowing beforehand whether a given case will be made better or worse by it.

Thibierge believes in its utility, but thinks it should be reserved for refractory cases where other remedies fail. It is in such cases that the treatment by thyroid feeding has scored its most striking successes. Age and sex seem to make little difference (Abraham[52]), although Eschle[64] thought fresh cases in young persons were more amenable to treatment by this method.

Radcliffe Crocker[76] of London considers it very valuable in "the right cases." Crocker says that it "should never be given during the increasing stage of the disease, as sometimes scores of new spots rapidly develop under it." He finds it "very capricious in its action, failing in one attack after it has succeeded in a previous one." "In children and sound young people it is often effectual."

Eczema.— Of twenty-two reported cases,[77], [78], [79], [80], [81], nine are set down as "cured," three as improved, two as unimproved, one as worse, and in seven the result is not clearly stated.

Ichthyosis.— Out of seven cases,[82], [83], [84], [85], [86], [87], one is called "cured," another "cured but relapsed when treatment stopped," four improved and one unimproved.

Of four cases of *Xerodema*,[88], [89], one showed improvement, the others none.

Two cases of *Sclerodema*,[90], [91], are reported, one improved and one was "cured."

Three cases of *Acne Rosacea*,[92], [93]. Two improved — Dr. Harold Williams' cases. One not improved.

Success is mentioned in single cases of adenoma sebaceum,[94], pityriasis rubra[95] and exfoliative dermatitis,[96] and failure in a case of vitiligo.[97]

Four chronic leg ulcers[98], [99], showed no improvement. Two cases of alopecia[100], [101], are reported improved, but McKenzie[102] claims to have tried it thoroughly, and found it useless in this disease.

Lupus.—The use of thyroid feeding in lupus seems to have been successful in the hands of Byron Bramwell,[103] Busch[104] and Abraham,[105] twelve cases[106] being reported all more or less improved. In five of these, however, local treatment was given at the same time. No complete cures are reported.

Phthisis.— This apparent success with cutaneous tuberculosis led Morin of Neufchâtel[111] to try the remedy in pulmonary tuberculosis, and he has been followed by Kraus[112] in Germany and T. Smith[113] in England. All of these observers report generally favorable results but nothing very definite or permanent. Morin believes the goitre and tuberculosis are antagonistic. He noted the frequency of atrophied thyroid in phthisis, and out of seventy-one cases of myxœdema found twenty tubercular. Girard, of Berne, noted that in the districts where goitres prevail, phthisis is more than twice as common in the non-goitrous as in those with goitres. It is a popular belief in these regions, he says, that goitre and tuberculosis are antagonistic.

Morin also reports a phthisical patient who improved markedly after acquiring a goitre. In one very tubercular family he found every member phthisical except those whose thyroid was enlarged. Kraus did not find that phthisical patients lost any weight under thyroid treatment, in fact notes a gain in weight in one case, but he found no change in the signs of the lungs.

During the past ten days I have been giving thyroid extract to six phthisical patients. No particular change has been noted.

Syphilis.—This remedy has also been tried in syphilis,[107], [108], [109], [110]. Six favorable cases are reported, five of them said to be very severe, while in eleven cases no improvement has been seen.

MISCELLANEOUS USES OF THYROID FEEDING.

1. Perhaps this is as good a place as any to speak of an interesting case of hypertrophied scar reported by J. W. White,[114] in which, during thyroid treatment, a large unsightly mass, resembling keloid, shrivelled away so as to leave only a linear scar. Dr. White had previously tried various local treatments with no success.

2. The unsuccessful use of thyroid feeding in cancer[115] needs no further comment.

3. At the Wiesbaden congress of last April above mentioned where the whole subject of thyriod feeding was discussed, favorable results were reported in a variety of conditions; for example, in chlorosis,[116] rickets,[117] gout[118] and diabetes.[119] The cases are too few and the reports too meagre for us to come to any conclusion about them.

4. A French observer (Jouin),[120] tried thyroid treatment in five cases of fibromyoma of the uterus, and noted marked diminution in the size of the tumors in two cases and diminished hemorrhage in three.

5. The fact that in myxœdematous children and cretinism the thyroid treatment is associated with notable *growth in height* has led some observers to try its effects in dwarfed children *not* myxœdematous,[121], [122], to see if their development could not be helped. I have collected *ten* such cases, three in idiotic children and six in whom the lack of development was mainly physical. A considerable increase in height was observed in all the cases, but the mental symptoms were not improved.

TABLE IV.—THYROID IN INSANITY.

Author.	*No. of Cases.*	*Improved.*	*Not Improved.*	*Worse.*
Reinhold (123),	12	0	12	Goitrous cases.
Bruce (124),	30	21	9	14 quite well.
McClaughry (125),	2	1	1	Goitrous cases.
Esterbrook (126),	1	1	0	Several others benefited.
E. P. Elliot (127),	3	0	3	
Clarke (128),	"Several."*	"Several."	?	Stuporous cases.
Scribner (129),	10	0	10	Lost 5–17 pounds weight.
Total.....	60	25	35	

This brings me to speak of *Insanity* as treated with thyroid. About sixty cases are on record. Twenty-five improved. Out of all who have tried the treatment, Bruce,[124] an English writer, is apparently the only one who feels sanguine as to its use. Twenty-one out of the twenty-five improved cases are his. He considers it a "valuable addition to the alienist's armamentarium in certain cases," and advised its use in cases of melancholia whose spontaneous improvement had come to a standstill; in maniacal cases without signs of dementia and in *stuporous* cases in early stages. He finds that women do better than men under it (an observation parallel to the results in obesity). It is con-

* Counted as 2 cases in totals.

traindicated in emaciated patients and those who eat poorly and in cardiac disease. Bruce's experience related to thirty cases, twenty-one of which showed improvement, amounting to recovery in fourteen. Clarke,[128] a Canadian writer, finds, like Bruce, good results in cases of stupor; several cases benefited, one or two recovered, one relapsed. In epilepsy[130] one author finds good effects and one bad effects from the treatment. At the Danvers Asylum and McLean Hospital for the Insane the thyroid treatment has been tried to a limited extent and without any beneficial effect on the mental symptoms.

At the Worcester Insane Asylum Dr. Scribner used it in ten chronic cases without any effect except a decided loss of weight, amounting in four cases to over fifteen pounds.

THYROID IN EXOPHTHALMIC GOITRE.

Although starting without any strong bias against the possible utility of thyroid in this disease, I have not been convinced by the literature that a further trial should be given it. Out of 85 cases published, 22 improved, 40 did not, and 23 were worse. (See Table V.)

The size of the goitre has diminished in many of these cases, but without corresponding general improvement. The number of those made worse is about equal to those benefited, and three-fourths show no improvement.

Nevertheless, some actual cures are recorded in obstinate cases, and there seems a possibility that in a certain type of the disease it may do good. In no other disease, however, does it so often do positive harm. On the whole, there is very little reason for hoping that it will do good in this condition.

Tetany. The last use of thyroid feeding of which I shall speak is in Tetany. Of twelve recorded cases,[159], [160], [161], [162], [163], [164], [165], [166], [167], only four showed improvement, but two of these were very obstinate and long standing cases,

TABLE V.—THYROID IN EXOPHTHALMIC GOITRE.

Author.	*No. of Cases.*	*Improved.*	*Not Improved.*	*Worse.*
Bogrof (131),	14	14	0	
Bergmann (132),	7	0	0	7
Mendel (133),	10	0	10	0
Stabel (134),	10	0	7	3
Leichtenstern (135),	4	0	0	4
v. Jaksch (136),	6	0	6	0
Putnam (137),	6	0	6	0
Brissac (138),	1	0	0	1
Kraus (139),	3	1	1	1
Voisin (140),	2	2	0	0
Schuster (141),	"Several."*	All.	0	0
Senator (142),	" *	0	All.	0
Béclère (143),	1	0	0	1
Silex (144),	1	1	0	0
Lemcke (145),	1	0	0	1
Lanz (146),	1	1	0	0
Revilliod (147),	1	0	0	1
Ferguson (148),	1	1	0	0
Cassellbury (149),	1	1	0	0
Shurly (150),	"Few."*	0	All.	0
Joffroy (151),	1	0	0	1
Ewald (152),	3	0	3	0
MacKenzie (153),	1	0	1	0
Sänger (154),	?	0	All.	0
Auld (155),	1	0	0	1
Cantu (156),	1	0	0	1
Nasse (157),	1	0	0	1
Noorden (158),	1	1	0	0
Total.....	85	22	40	23

* Counted as 2 cases in total.

and have shown no relapse in a period of five months. Possibly here, as in many other conditions, thyroid feeding may help to distinguish different types within each disease, according as they are or are not affected by the thyroid treatment.

It may be that there are the "thyroidal" and "non-thyroidal" types of obesity, psoriasis, tetany, insanity. In the case of obesity we seem to be already in possession of some criteria by which we can tell beforehand whether or not a given case is likely to be benefited. In the other conditions such criteria are very scanty, but there seems to be some ground for hope, that thyroid treatment may enable us to split up several supposed entities of disease as we have split up jaundice and asthma, and show them to be simply symptomatic of a number of different underlying conditions.

To sum up the impression gained from the study of the literature of thyroid feeding it seems to be: —

1. Of great value in simple parenchymatous goitre, especially in young people.

2. Of considerable value to reduce weight in obesity especially in the anæmic, flabby types, and provided the relapse is prevented by diet and exercise.

3. It seems to deserve a further trial in obstinate cases of psoriasis, sclerodema and lupus; also in tetany, certain phases of insanity, and retarded development in children.

4. In exophthalmic goitre it rarely does good and often harm.

5. In chlorosis, rickets, diabetes and tuberculosis, the evidence is not sufficient to warrant inferences.

A few words as to the form in which the thyroid is to be given. Many of the most successful recent results in Germany have been with the fresh gland, raw or fried.[1], [10], [111], [168] There is little doubt that this is superior to the German dried extracts. Whether or not it is superior to English and American extracts we have no sufficient evidence to show. The fresh gland is very unpalatable, but may be given by the rectum.

Attempts have been made in Germany to extract the active principle of the gland, and Fraenkel's "Thyreoantitoxin"[169] and Baumann's "Thyrojodin"[170] are now being experimented with in Germany. The latter preparation is an iodine compound, and considerable success in the use of it was reported by Ewald and others at the Wiesbaden Congress two months ago to-day. The doseage is exact, and it is free from some of the unpleasant toxic qualities of the dried preparations of the gland.

I have alluded to some dangers attending the use of thyroid preparations. Bad symptoms caused by it are probably of two kinds.[171] (1) The physiological action an of over dose of the gland itself. (2) Ptomaine poisoning due to products of decomposition included in the dried preparation of the gland. These two chains of symptoms are often lumped together under the name of "Thyroidism."

"Thyroidism" is first shown by *rapid pulse and palpitation;* cardiac oppression, and angina, even fatal in a few cases may occur. Anorexia, nausea and vomiting, diarrhœa, lassitude, malaise, faintness, vertigo, headache and pain in back and extremities, are not uncommon; hysterical manifestations, and, rarely, aphasia, monoplegia, convulsions, and even coma, occur. With some preparations urticaria, erythema and eczema are produced.[172, 173, 174] An odor to the skin and perspiration is sometimes noted. I have had two patients speak of this.

In those predisposed to diabetes by inheritance a temporary *glycosuria*[176] may occur,* and V. Noorden[175] hopes that we may in this way be enabled to make an early diagnosis of diabetes.

In giving thyroid preparations the best guide is the pulse. *Any considerable quickening thereof or palpitation should lead us to discontinue the drug until the cardiac*

* v. Jaksch (14th Cong. Wiesbaden) doubts whether the reduction of copper in these cases is always due to sugar.

action is again normal. There are no dangers in the use of the drug provided we begin with small doses, one to two grains of American extracts, and gradually increase, watching the pulse. It should never be given to a patient who cannot be closely watched.

SUPRARENAL EXTRACT IN ADDISON'S DISEASE.

Since Rollestone's remarkable Goulstonian lectures on the Suprarenal Bodies, in which he recommends a trial of the extract of these glands for Addison's disease, a certain number of cases have been reported. I have been able to collect only twenty cases, out of which nine have been considerably improved. The use of the preparation is still in

TABLE VI.

SUPRARENAL EXTRACT IN ADDISON'S DISEASE.

Author.	*No. of Cases.*	*Result.*	*Remarks.*
Parkinson (177),	1	Worse.	Died soon after.
Turney (178),	1	Worse.	" " "
Ringer & Phear (179),	1	Temporarily better.	" " "
Pitres (180),	2	Worse.	Subcutaneous use.
Spellman (181),	3	Two no effect. One greatly better, but relapsed.	Using alcoholic extract.
Stockton (182),	1	Nearly well.	Bronzing gone.
Osler (183),	1	Much better.	No relapse (3 months).
Sansom (184),	2	Temporarily much better.	Relapsed and died.
Jones (185),	1	"Cured."	
Oliver (186),	2	One "practically well." One greatly better.	One diagnosed by Pye Smith.
Maragliano (187),	?	Good results.	Glycerine extracts.
Shoemaker (188),	1	Improved.	
Stewart (189),	1	Not better.	
Epelbaum (190),	2	Much better.	Fresh gland raw.
Zuco & Foa (191),	?	No improvement.	Used watery extract.
Shattuck (192),	1	Apparently well.	
Total.....21			

its infancy and these cases represent trials of watery, alcoholic and glycerine extracts as well as of the gland itself, raw or dried, so that it is misleading to lump them all together and judge of the results. The various fluid extracts are evidently very inferior to the gland itself, dry or raw.

One case under the care of Dr. F. C. Shattuck at the Mass. General Hospital I had an opportunity to observe. Dr. Shattuck felt no doubt of the diagnosis, and no improvement occurred until after the use of the dried extract of the suprarenal body. The patient is now, to all appearances, well and has been so for four months. An absolute diagnosis of Addison's disease is, I believe, impossible without an autopsy, so that a certain amount of doubt is thrown on the apparent benefit derived from this mode of treatment in genuine Addison's disease; but when we have improvement recorded in cases diagnosed by such clinicians as Pye-Smith, Osler and F. C. Shattuck, we cannot help feeling hopeful about the treatment, especially as on physiological grounds there seems to be reason to expect that it would work well.

Experiments with suprarenal extract have shown it to have the property of increasing blood pressure by stimulation of the vagus and cardiac muscle and also of contracting the calibre of the periphery arteries[186].

Acting on this suggestion, Bates[193] has used it as a local astringent and hæmostatic in operations on the eye and also in glaucoma and conjunctivitis. Oliver[186] and Clark[194] have used it with benefit in diabetes insipidus, and its use has also been praised in three cases of diabetes mellitus, in hysteria and neurasthenia with loss of vaso motor tone, and in certain forms of anæmia[186].

It is evidently a powerful medicinal agent and severe toxic symptoms have been recorded in connection with its use[195], [180], but on the whole there seems to be reason to

feel hopeful about its use. Certainly it deserves a further trial in a disease for which no other treatment has hitherto availed anything.

EXTRACT OF PITUITARY BODY IN ACROMEGALIA.

The records of this subject are very scanty. I have been able to collect only nine cases of its use[199], [200]. Five of these appear to be more or less improved. Three of these are reported by Marinesco[196]. The headache and other pains improved, the general condition was better and the extremities smaller. One case was able to move the hands better and walk with less fatigue than before.

One favorable case comes from England under Bramwell's[197] care and another from Germany. In these two, thyroid extract had previously been tried without success. In the German case reported by Mendel[198], the knee jerk, which had been absent, returned and the condition of the teeth and gums improved.

Thyroid treatment has also been tried for acromegalia in ten cases, six of which have improved and four not improved[201 to 209]. As both the thyroid gland and pituitary body are sometimes found diseased at autopsy in acromegalia, it may be that the simultaneous use of both extracts will be found useful.

BONE MARROW.

Since ordinary forms of anæmia yield readily to treatment by other drugs, it is chiefly in pernicious anæmia and leucæmia that we have hoped for help from bone marrow. But I have been unable to find accounts of a single case of undoubted pernicious anæmia which has shown any permanent improvement. The case of Danforth's[210] which attracted so much attention at the time it was reported in October, 1894, has since[211] relapsed and died, and there is no reason to suppose that the temporary improvement had any connection with the treatment.

The cases of Frazer[212] and Bigger[213] both lack a satisfactory blood examination, and their subsequent progress after the first few months is not recorded. The other cases reported as improved (nine in number) are defective either as to diagnosis or as to the subsequent progress of the case. Temporary improvements are so common in pernicious anæmia, with any treatment as well as without any, that no case can be called cured unless the improvement has persisted at least two years. There are no records of improvement in leucæmia; four are reported not improved.

In secondary anæmia and chlorosis we have a considerable number of favorable reports. Fifteen cases of chlorosis and chloro-anæmia are all said to have improved, and in two of these Blaud's pills are said to have had no effect. Seventeen cases of secondary anæmia, including four of rickets, are also recorded as improved. But these anæmias are easy to cure as a rule, and as marrow contains iron it is not remarkable that improvement was noticed.

Two cases of anæmia infantum, pseudo leucæmia, are reported by Combe,[228] a French observer, as cured by bone marrow, but there is reason to doubt the diagnosis.

On the whole, there seems to be less reason to expect good results from the use of bone marrow than from any of the other animal extracts I have mentioned.

CONCLUSIONS.

Thyroid extract is certainly valuable.

Suprarenal extract we have reason to hope will be proved so.

Pituitary extract we cannot judge of as yet.

Bone marrow is in all probability useless.

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ARTICLE XII.

LORENZ'S OPERATION IN CONGENITAL DISLOCATION OF THE HIP.

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READ JUNE 9, 1896.

LORENZ'S OPERATION IN CONGENITAL DISLOCATION OF THE HIP.

THE various methods of treatment of congenital dislocation of the hip may be said at present to be under investigation. The report of the ultimate results are of importance, meaning by the term "ultimate results" the results some years after treatment has been abandoned. The two methods of treatment at present in use may be classed, first, as that of stretching, by mechanical means, of the shortened muscles and ligaments, followed by a retention, by means of appliances, of the limb or limbs in the position newly gained, in the hope of the formation of an artificial socket sufficiently strong to sustain the weight of the patient in subsequent locomotion. The second method, namely the operative, includes both the treatment by forcible reduction, and the methods of Hoffa, Lorenz and others, for the establishment of a new acetabulum by the knife and the curette. At a discussion on the subject in the Berlin Medical Congress before the Orthopedic Section, the claim was made that no single case could be found recorded where, ten years after treatment by means of traction, a cure had been established. The following cases represent the ultimate results in a few cases several years after treatment by traction:

Case I.—A young girl of seventeen, suffering from congenital dislocation of both hips. At the age of ten she had undergone treatment by traction efficiently carried out for nearly a year. This was followed by the use of a

leather corset moulded to the trunk with the patient in as nearly a correct position as possible, the lower portion of the corset pressing down upon the trochanters and upon the sacrum, the corset being kept from riding upwards by means of perineal straps. Appliances of this sort were worn for several years. These were discontinued and at present, at the age of seventeen, the young lady walks with but little peculiarity of gait when she is careful in her locomotion. The lordosis of the back is not marked when the patient is dressed, but is noticeable in her bared back. It cannot, however, be claimed that the results in this case were effected by treatment to any considerable extent. The patient is a muscular girl, and by the use of her muscles, and by training is able to maintain a fairly correct attitude.

Case II.—A girl of the age of fifteen, has grown rapidly in the last three years. At the age of five she was subjected to treatment by traction for a year; subsequently, corsets were used. The patient is at present not a muscular girl, and walks with a most distressing limp and with marked lordosis. During the last year she has gained somewhat in muscular strength, and is walking better. The course of the affection has not in any way been altered by the treatment.

Case III.—This patient has been reported before the Orthopedic Association as under treatment by traction. The treatment was most thorough, and carried out with great care for three years, traction being employed, no weight being allowed to fall upon the head of the femur during that time, with attempts to develop a new socket in the normal position of the acetabulum, and for two years later only an imperceptible amount of weight was allowed, the joint being protected by apparatus as described in the Transactions of the American Orthopedic Association, Vol. IV. A perfect cure was anticipated at this time. At present the tops of the trochanters are an inch above the Nelaton line, and are firm in their position, and are not dislocated backwards. The patient is now eleven years of age, and has been under gymnastic treatment for the last three years; mechanical treatment having been discontinued ex-

cept the use of a stiff corset. The patient walks with a fairly good gait, without the characteristic waddle when her attention is directed to this; but when tired her gait is characteristic. When the back is bared a marked lordosis is seen, but when dressed with her corset this is hardly noticeable. The patient is strong and is developing in strength. In this instance the most that can be said of treatment is that an improved position of the heads of the femur was gained. The trochanters are certainly lower than at the time treatment was undertaken, and appear to be firm in their position. The most that can be claimed is that the patient walks better than if no treatment had been undertaken.

Case IV.—The following patient, a young lady of eighteen, presented herself for advice in regard to flat feet. She was strong and well developed, and had the characteristic gait of double congenital dislocation. She had, at the age of five, submitted to thorough treatment by traction for several years, and a cure was at the time established, as was thought. At the age of eight the trochanters were in a normal position. There was no lordosis, and the patient walked well. At the time when the patient presented herself to me, the changes in figure and weight following development had taken place, and the trochanters were well above the Nelaton line, a well-marked dorsal dislocation having been established with resulting lordosis. In other words, as the patient's weight had increased, the characteristic deformity had been established.

It would appear, therefore, from these cases that the most that can be expected from treatment by traction is an arrest of the development of the deformity, and in some cases the prevention of the worst forms of this deformity, and that even in some instances where least expected, after the developments of growth and weight have been established. Under the circumstances it can fairly be questioned whether the surgeon is justified in subjecting the patient to the tedium of thorough traction treatment, with confinement in bed for years, as has been carried out in some of the cases here reported.

As a substitute for this treatment, the following simple method has been used. It consists simply of the use of a traction splint which is made of a modified Thomas ring knee-splint with a traction attachment. The patient walks about with this, wearing it night and day. No weight is thrown upon the acetabulum, as by muscular exercise the trochanter is brought down to nearly its normal position. It is thought that in single congenital dislocation this method would answer all purposes of expectant treatment. This method can also be carried out, though less efficiently, in double congenital dislocation, and certainly is less irksome to the patient than the expectant methods hitherto recommended.

The results in this method, judged by four cases in which it has been tried, seemed as satisfactory as that obtained from the treatment involving confinement in bed. It cannot, however, be said that the results are satisfactory or the method is scientific.

The use of a stiff corset pressing upon the trochanters, moulded to the shape of the trunk, and furnished with perineal straps to prevent the riding of the corset upwards, has been used by a few surgeons, especially in Germany. The material of the corset varies from that of the plaster of Paris to leather stiffened with steel, or, as has been used by Hessing and Hoffa, of steel supports fitted especially to the trunk and bearing upon the pelvis. Some improvement in the carriage of a patient is seen, but the method is only palliative.

OPERATIVE MEASURES.

Forcible Correction. Dr. Post, of this city, fifteen years ago succeeded under an anæsthetic in reducing a case of congenital dislocation in a child, employing the methods of manipulation recommended by Dr. Bigelow. He was unable, however, to retain the head permanently

in the proper position. This method is substantially that recommended by Paci of Italy, but the number of cases in which it would be applicable, judging from pathological evidence, is so limited that the method cannot be generally recommended.

HOFFA'S METHOD.

At the Berlin International Medical Congress, Hoffa of Wurzburg reported the method of operative treatment which has come into extensive use and is known by his name. The method consists of Langenbeck's incision with opening of the capsule from behind, and carefully freeing of the head and neck from all the capsular attachments. The limb is pulled down, and an attempt made to place the head in the point where the normal acetabulum should be situated. This is hollowed out by a sharp currette, and a new acetabulum is made in the normal position. Hoffa claims that the obstacles to the cure of congenital dislocation are all in the ligaments and muscles, and that a thorough division of the attachment of the muscles about the greater trochanter, together with the deepening of the acetabulum, was sufficient to establish a cure. He himself has operated with success in a large number of cases, limiting his operation chiefly to children of five years of age. Hoffa's operation has been extensively performed by other surgeons, notably Kirmisson, Karewski, Lorenz, Bilhaut, Koch, Mikulicz, Broca, Gibney, Burrell, Lovett, Goldthwait and others; but although the method is based upon correct pathological principles, it is open to criticism in regard to surgical technique. The operation has been performed upon eleven patients at the Children's Hospital since 1892, but in no case has benefit followed the operation. The operation involves considerable mutilation of the muscular attachments and a very extensive dissection. Furthermore it does not divide directly the parts chiefly concerned

in continuing the dislocation, and does divide some of the important tissues which are not concerned in holding the head of the femur in the dislocated position.

LORENZ'S METHOD.

An examination of a fresh dissection of the case of congenital dislocation of the hip proves conclusively that the chief obstacles to the reduction lies not in the muscles, but in the capsular ligaments and especially in the anterior bands. (See Transactions of the American Orthopedic Association, Vol. VII.) Unless these shortened tissues are lengthened, it is impossible to place the head of the femur in the proper position. These can be divided from the posterior incision used by Hoffa, but only after a very extensive dissection, and much less directly than if the incision is on the anterior surface as recommended by Lorenz. The success reported by Lorenz of Vienna has been so remarkable that his method deserves careful consideration. Previous to the operation, the patient is to be submitted to thorough traction in order to stretch as far as possible the muscular tissues, and avoid muscular division and injury which necessarily interferes with the excellence of the ultimate result. He also desires to avoid during the operation muscular incision as far as possible. The anterior bands of the ileo-femoral ligaments are divided, and such as are not divided are to be thoroughly stretched during the operation; and unless the head of the femur is brought down to its normal position, the operation is imperfectly performed. The details of the operation may be described as follows:

The child should be carefully prepared with antiseptic precautions, and should be subjected to a treatment of traction of from five to ten pounds for eight or ten days before the operation. The leg should be brought into position of slight abduction with a slight pull downwards; an incision is made which begins from the anterior superior spine (or

a millimeter outside to avoid the anterior cutaneous nerve), and should be continued in the direction of the outer edge of the tensor vaginæ femoris muscle, six or seven centimeters downwards and a little outwards. The incision extends through the sub-cutaneous tissue to the muscles; the small vessels need no ligature. The fascia should be divided above and down to the anterior border of the gluteus medius muscle. After the tissues are separated, the anterior capsule should be laid bare. On moving the leg the position, size and shape of the head can be examined. The capsule is then incised, the muscles should not be divided, but stretched, except that a few fibres may be divided in some instances to give sufficient room.

OPENING OF THE CAPSULE.

After the capsule has been laid bare, the assistant moves the leg by twisting it outwards, in order to stretch the anterior walls of the capsule. The knife is to be inserted near the anterior inferior spine through the capsule, until it reaches the head of the femur. The capsule is then divided in the direction of the neck until the ridge of the shaft of the femur is reached. The second division of the capsule crosses at right angles over the head of the femur. The lower arm of this cross incision reaches to the inner border of the rudimentary acetabulum. The head of the femur can then be brought out, and the neck thoroughly felt. The ligamentum teres can then be incised, and the acetabulum examined.

SHAPING OF THE HEAD OF THE FEMUR.

This is rarely necessary. Sometimes the neck is short. Under these circumstances there is nothing to be done except to free the insertion of the capsule and to push it back. If there are adhesions between the head and the capsule,

they must be separated; sometimes an irregular projection must be removed from the head of the femur.

FORMATION OF THE ARTIFICIAL ACETABULUM.

Boring instruments are to be avoided. The bayonet-shape curette is preferable to the straight one with the cup at the side and not at the end of the shank. The curette must be used more as a knife and less as an instrument for boring, and should be sharp at the edge. It is of the greatest importance that there should be sufficient size and depth to the new acetabulum.

REPOSITION OF THE HEAD OF THE FEMUR.

When the acetabulum is made sufficiently large, the head is to be put in its proper place. It will be frequently found that the head cannot be pulled down sufficiently to lie under the upper edge of the acetabulum without force; under these circumstances the limb should be pulled down slowly and gradually, using considerable force. If it cannot be placed in a proper position, the business of the operator should be to find out the obstruction. It is frequently caused by the capsule covering of the acetabulum not being sufficiently opened. Sometimes a fold of the capsule interposes, or the entrance of the acetabulum is too small. After the reduction has taken place, it must be tested for its solidity, and the limb must be moved in various directions. If this is not satisfactory, the acetabulum must be made deeper. If the position of the limb (owing to the defect from a curve of the shaft) is a bad one after the operation, the correction of the deformity may be left to a later osteotomy. There is no need of suturing the cut capsule, but the incised skin is sewn with catgut. The patient is placed in a plaster bandage without traction.

The steps of the operation may be mentioned as follows:

The preparatory pulling of the head downwards.

Section of the skin and laying bare of the capsule, separation of the fascia between the posterior head of the tensor vaginæ femoris and the anterior edge of the gluteus medius without injury of the flexor muscles. The opening of the anterior border of the capsule by means of a T insertion, which spares as far as possible the capsule covering the acetabulum.

Shaping of the neck and head of the femur, in rare instances.

Deepening the acetabulum.

Re-position of the head.

Placing of the limb in a slight position of abduction.

The brilliant success reported by Lorenz in over 200 cases is sufficient to justify the attention of the surgical world. The method involves much less mutilation than that of Hoffa, and is applicable to older cases.

The accompanying three cases are of interest in this connection:

Case I.—J. L., a girl of seven years, was operated upon in October, 1895.

Case II.—A. J., a girl of four, was operated upon in February, 1896.

Case III.—X. Y., a girl of three, was operated upon in March, 1896.

In the first of these cases the anterior incision was more free than according to the method described by Lorenz. No difficulty was met in placing the head of the femur into the acetabulum. The patient was treated after the operation by traction, and a traction splint applied. At the end of six months the traction splint was removed, and the patient allowed to walk. The head of the femur remained firmly in the new acetabulum. In the two succeeding cases no traction treatment was applied after the opera-

tion, the head of the femur was placed firmly in the deepened socket; plaster of Paris was applied to the partial abducted limb and secured in that position. At the end of six weeks the patients were allowed to walk, and at the present time are walking about freely; the heads of the femora remaining firmly in the sockets, although before the operation they were upon the dorsum. In the first instance no appreciable shortening exists after the operation, although over an inch was present before. In the second, the shortening before operation of an inch was present. After operation a slight shortening of a quarter of an inch is to be seen, due either to a lack of perfection in the making up of the new acetabulum, or to a shortening of the neck of the femur.

The healing of the wound was rapid, without any interference. Motion at the joint became marked on removal of the plaster of Paris bandage — three weeks after the operation.

These results, though recent, correspond with those reported by Lorenz, which have been tested as to permanency by several years' use, and may be regarded as confirming, as far as they go, his experience.

At a recent meeting of the American Orthopedic Association, Lorenz submitted a communication recommending the treatment of congenital dislocation by means of non-operative traction, but applied in a different method from that hitherto used and designed, so as to stretch the anterior bands of the capsular ligaments more thoroughly than can be done by ordinary traction. The result of this method is useful only in cases of very young children, and the value of this method is yet to be determined; for older cases Lorenz's method of operation recommends itself as safe and curative.

ARTICLE XIII.

THE TREATMENT OF CLUB-FOOT.

By AUGUSTUS THORNDIKE, M.D.
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READ JUNE 9, 1896.

THE TREATMENT OF CLUB-FOOT.

THE limits of this paper compel me to speak only of the treatment of Congenital Equino-Varus. All cases vary from the therapeutic stand-point in two ways: in the amount of *distortion*, slight, moderate or severe; and the amount of *resistance* offered to manual replacement.

Either age or a relapse after the deformity has once been corrected are adverse factors, and modify not only the prognosis but lead to the selection of a more radical method of treatment. For instance, a child of fifteen, with moderate equino-varus, may, with suitable apparatus, bring the foot into a correct position, and after retaining it there by an appliance for a year abandon the apparatus and be cured permanently. On the other hand, a child of the same age who has been straightened and relapsed presents a more resistant foot and much greater difficulties to the orthopedist, and will usually require open incision or even osteotomy. It is, therefore, not surprising to find a number of different procedures advocated. Every case, whether operative or not, requires mechanical treatment for a considerable time, —six to eighteen months after the deformity has been entirely corrected—to prevent relapse. A partial correction of club-foot is useless, for relapse will surely follow.

The mildest form of correction consists in manual replacement two or three times a day by the parent, bandaging with a soft flannel bandage between whiles. This is obviously useful only in the mildest cases and in very young babies.

With adhesive plaster the foot may be kept corrected a little more firmly, but in most babies a firm retentive apparatus is necessary; either a light plaster bandage applied holding the foot corrected as far as can be comfortably borne until the plaster has set, or else a light tin shoe in which the foot is strapped with adhesive plaster or bandage. The importance cannot be overestimated of beginning treatment at once in very young infants, for their feet are less resistant the younger they are.

Another useful apparatus consists of a light wire upright having a spur of fairly stiff wire towards which the foot may be drawn by the turns of the bandage. But the form of appliance now most commonly used for babies at the Children's Hospital consists of the Taylor club-foot shoe, slightly modified, and applied with an adhesive plaster extension strap to keep the heel down, the upright being continued to the waist where a long posterior arm serves to evert the foot. The shoe is first applied to the sole of the foot, irrespective of the position of the upright, and is firmly fastened by adhesive plaster and bandage; the foot is then brought into correct position by pushing the upright into place, where it is held by the strap and bandage. These shoes are worn two or three weeks continuously and reapplied many times. By bending the upright the foot can be over-corrected after several applications. This apparatus is also useful after operation.

Another modification of the Taylor club-foot shoe, recently devised by Dr. E. H. Bradford, is for older and more resistant cases. The object of this apparatus is to secure a firm grasp of the os calcis and astragalus before applying any force to correct the inward and downward displacement of the anterior part of the tarsus. It consists of a Y strap so applied that the tail of the Y passes under the sole of the foot from without inwards, while the two branches pass, one around the heel securing the rear part of the calcaneum,

and the other over the outer side of the neck of the astragalus. In this way a very firm grasp of the os calcis is first obtained and the correction effected by bringing the upright against the leg as in the ordinary Taylor club-foot shoe.

The more resistant forms of club-foot require operation and prolonged mechanical after-treatment.

Operations may be divided into three groups: —

1. Tenotomies.
2. Incisions.
3. Operations on the bones. Osteotomies and excisions.

TENOTOMIES.

In the severe infantile cases tenotomy aided by a moderate amount of force applied with the hand is sufficient. In the older and more resistant feet, where greater force is needed, the Thomas wrench or the lever of Bradford is used after tenotomy to obtain correction. The principle of these instruments is simple and effective. Tenotomy for club-foot at the Children's or the Good Samaritan Hospitals is usually done upon the following simple rule: "to divide any and all bands which can be felt tense when the foot is held as nearly straight as possible, taking care to avoid the arteries and nerves." The following structures are sometimes divided: the plantar fascia, tendo Achillis, tibialis anticus, tibialis posticus and abductor pollicis muscles, and the anterior portion of the deltoid ligament, part of the astragalo-scaphoid ligament or of the calcaneo-scaphoid ligament. Most operators prefer not to divide the tendo Achillis until the varus position has been entirely corrected, and sometimes this is left for a subsequent operation.

If the deformity cannot be completely eradicated by tenotomy it is better to do an open section *à la Phelps* at once; for partial correction means relapse. After tenotomy and replacement with the lever a small sterile gauze

dressing is applied, and a plaster bandage from the tips of the toes to half way up the thigh, the knee being partly flexed, otherwise the bandage will twist and allow the toes to point in. When the plaster is removed a retentive apparatus, generally one of the modified Taylor club-foot shoes, is applied and constantly worn till all danger of relapse is over, *i.e.*, one or more years.

OPEN INCISION.

The method of Phelps has become of late the favorite method of treating resistant cases. An incision is made from the centre of the sole to a point a finger's breadth in front of the internal malleolus, and is carried successively through all resisting soft parts to the bone if necessary, until the foot can be brought into an over-corrected position and stay so. The incision is then covered with a strip of sterile gutta percha tissue, and a sterilized gauze dressing applied with plaster bandage, allowing the wound to fill and heal by blood clot.

The operation may be rendered bloodless by the Esmarch bandage. The dressing if sterile may remain a month. The retention shoe may be applied with dressings before the wound is healed. After-treatment must be long continued, as relapses sometimes occur.

BONE OPERATIONS. OSTEOTOMIES — EXCISION OF ASTRAGALUS.

Bone operations involve mutilation of the skeleton of the foot and are done only when the operator fails to correct by the Phelps method. It should be done at the time of the other operation, and, usually, a linear osteotomy of the neck of the astragalus or of the anterior part of the calcaneum will enable the over-correct position to be reached.

Wedge-shaped exsection of the tarsus involves too great mutilation and is seldom called for, even in the most resistant of adult cases.

Excision of the astragalus is seldom done at the Children's or Good Samaritan Hospitals, and I have yet to see any club-foot I would amputate. All club-feet are curable either by mechanical means alone, or by a simple operation followed by mechanical treatment. Failures are due primarily to insufficient after-care, either because the mechanical treatment is not kept up long enough, or some important detail is neglected.

ARTICLE XIV.

MEASUREMENTS IN SPINAL CURVATURE.

By GEORGE W. FITZ, M.D.
OF CAMBRIDGE.

READ JUNE 9, 1896.

MEASUREMENTS IN SPINAL CURVATURE.

Cases of lateral curvature present so many complicated and varied conditions, and the changes are so discouragingly slow in many instances, that accurate measurements are of great importance for showing the progress of the disease and the effect of treatment.

For a complete record the spinous processes from the seventh cervical down to the sacrum should be spotted with a black flesh pencil, also the posterior-iliac spines. The simplest way to get the record is to photograph the patient thus prepared immediately behind a screen, consisting of a rectangular frame with threads strung vertically and horizontally, cutting the entire surface into inch squares. The photographic outfit is inexpensive and the whole process is extremely easy in a well-lighted room. This gives a photograph of any aspect of the individual, with the means of measuring with comparative exactness any detail that is desired. Taking the straight line joining the seventh cervical vertebra and the mid point of the sacrum (cervico-sacral line) as a convenient basis, we can measure the length of this line, its inclination to the vertical, the points at which it crosses the line of spinous processes, the levels of points of greatest deviation of the line of spinous processes, the extent of such deviation, and the distances to the sides of the trunk at different levels. By means of the horizontal threads of the screen the height of the shoulders may be determined, the level of the pelvis, etc., etc. Successive photographs can be taken for comparison, and of course must be taken under as nearly the same conditions as possible.

The advantage of the photographic method of recording lies especially in the following particulars: the entire set of conditions is obtained at one instant, so their relations to each other have not become deranged by movement, the patient has not been made self-conscious by overmuch handling and stands in an unprejudiced position.

It is important also to measure the amount of rotation of the spine. This can be done indirectly by measuring the amount of antero-posterior deviation of the ribs on the two sides. The most convenient method for doing this is to take the shape of the back by moulding a strip of lead to it and transferring this to pasteboard by means of a pencil. This pattern cut out forms a gauge which may be applied to the back and corrected until it fits perfectly, when it serves as a permanent index to change in rotation. It is possible to get the entire contour of the chest by having a strip of lead long enough to encircle the chest, cut in two and a small brass hinge inserted. The strip is then moulded around the chest and the hinge permits it to be opened and then re-closed on the sheet of paper for drawing the outline. Measurements should be taken under the same conditions as at first. It is best in many instances to take measurements both standing and lying, or in suspension, for determining the degree of correction possible.

Measurements of strength may be taken, also of weight, height, amount of chest expansion in extreme inspiration and expiration, of flexibility of the spine, forward and backward bending and sidewise bending, right and left. Measurements should be made every six months, or more frequently in rapidly changing cases. It should be borne in mind that many of the conditions involved in spinal curvature are vague, and that careful measurements which will form the basis for statistical study of the subject are of great value.

ARTICLE XV.

PRINCIPLES OF TREATMENT OF LATERAL CURVATURE.

By ELLIOTT G. BRACKETT, M.D.
OF BOSTON.

READ JUNE 9, 1896.

PRINCIPLES OF TREATMENT OF LATERAL CURVATURE.

For the convenience of description in treatment of lateral curvature, cases can be divided into two classes, representing, not different types, but different stages of one condition, which is distinctly progressive. For our purpose we must consider that, without respect to etiology, the condition is primarily one of a twist of the spinal column, causing a distortion in the symmetry of all parts attached, which depend on it for their support and for their relative position, and therefore any deviation from this normal position and shape of the spine results in a deformity in the trunk, as is seen by change in the contour of the body, in the familiar examples of a high shoulder, prominent hips and scapula, and high hips. As the development of bone takes place in the position in which the part is held, this condition of lateral curvature then becomes a gradually increasing one, both in the increase of the distortion of the position of the spine, as well as in the shape of the bones. The change in the position of the spine occurs in two directions, (1) a lateral bending of the spinal column as a whole, and (2) a rotation of the different segments one on the other; and resulting from these two changes in position, are such alterations in the contour of the body as is evident in the shape and position of the shoulders, scapulæ, waist and hips, and the relative prominence of the two halves of the trunk. As the deformity progresses, and as growth

occurs during its existence, bony change takes place, which offers an additional obstacle to the correction of the deformity, and the treatment therefore varies to a considerable extent, according to the stage to which this condition has progressed. The classes into which these are divided have no distinct boundary lines, but rather serve to designate the degree to which the deformity has developed.

The first class includes cases of such slight degree, in which little or no bony change has occurred, that they present no obstacle to the complete or even over correction, and are therefore to be regarded as postural curves.

The second class includes those cases in which the deformity has existed so long that definite structural changes have taken place, in the bones and ligaments and muscles, and present a distinct obstacle to the complete restoration.

The first class, although postural in character, yet present definite conditions toward which the treatment must be directed; although but slight structural change exists, there is a disturbance of normal function of the spine, as is shown by a limitation in the flexibility and strength in certain directions, so that it becomes easy for the spine to assume a particular mal-position. The treatment must therefore be directed to overcome this asymmetrical development, having for its object, first, to bring about a flexibility of the spine, normal in amount and symmetrical in character, so that the trunk may be held with ease in its normal position; and second, to so improve the muscle strength, and muscle action, that it is held in its normal position without conscious effort on the part of the patient.

The first of these is accomplished by exercises designed to stretch the shortened ligaments, and may be accomplished by vigorous body movements, or by exercises aided by mechanical means. The second, by the use of gymnastic exercises, carried out with the body in a corrected or over corrected attitude.

In the second class of cases there exists a marked obstacle to correction, in the more pronounced curve in the spinal column, the change in shape of the vertebral bones and the ribs, and in the limited flexibility. The object of treatment in these cases is two fold: (1) To so increase the range of flexibility in the necessary region of the spine that correction to a greater or less degree is possible; that is, to bring about a condition in which the patient can be made straight, or nearly so. (2) To then hold the spine and trunk in nearly as possible this condition, whether by means of apparatus or by increased muscle development, or both, while the bones are being shaped and ossification is taking place.

The principle used to accomplish the first of the measures, that of increasing the flexibility in certain regions of the spine, has long been used by contortionists and dancers, and consists of increasing the mobility of any part of the body by repeatedly forcing to beyond the point of the existing range of motion, thus stretching the ligaments and muscles. The application of this principle to the condition of spinal curvature is attended by the same results, and it has been definitely proved that it is possible to increase the flexibility of the spine in any region and any direction. This may be done by forcible exercise, aided by manual pressure by an assistant, but it is difficult by this method to closely localize and isolate the force. A more accurate way is by the so-called mechanical correction, by which the desired amount of force can be applied to any part of the spine, and in any direction with an accurate graduation, the advantage of the method being in its precision. There have been numerous forms of apparatus used for this purpose, many of which are of considerable value; as examples of these can be seen the modification of Hoffa's apparatus, in which the patient is partially suspended, the shoulders and hips secured by means of clamps and pads, and the desired

amount of rotary force applied to the trunk, which has a distinct effect on the rotation of the spinal column. This is used as an exercise of pressure alone, and also combined with breathing by which the effect of respiratory force is added.

A second form is that of the rocker, in which the patient is made to lie on an oblique frame, so arranged that it may be bent above and below at the point where pressure is desired to be made. In this way the force of gravity or superincumbent weight is avoided, and muscular action eliminated, and by this it is possible to increase the backward flexibility of the spine and the rotation in any point desired.

This portion of the treatment must be supplemented by some method by which the spine is held in the best position it will allow, during the process of growth and development. In cases of slight degree, it may be possible for the individual to maintain the corrected position by voluntary effort, and improved muscle action. This, however, is hardly to be expected in the cases of greater severity, where it is possible only by continued and considerable effort, and in this some form of support is needful.

ARTICLE XVI.

THE TREATMENT OF BOW-LEGS AND KNOCK-KNEES.

By FRANK E. PECKHAM, M.D.
OF PROVIDENCE, R. I.

READ JUNE 9, 1896.

THE TREATMENT OF BOW-LEGS AND KNOCK-KNEES.

THE deformities to be considered are essentially rhachitic, and while applying the appropriate mechanical or operative measures for their correction the constitutional treatment must not be forgotten.

It is this treatment that renders the bones firmer and the muscles harder, so that when the legs are once straightened there is no relapse to their former crooked condition, and it is readily seen that this is of the utmost importance.

The food must be regulated and the hygienic surrounding of the patient carefully considered, that all the conditions may favor a return to health without a single hindrance.

In addition to the usual doses of cod-liver oil and iron, or whatever medication the individual physician may prefer, a salt-water bath should be given every morning, and the patient thoroughly rubbed with a coarse towel. During the day all the fresh air and sunshine available should be utilized. At night a kneading of the muscles, immediately followed by appropriate leg exercises in the reclining position, prepares the patient for a refreshing sleep.

There is no disease or deformity where the possibilities of preventive treatment are greater than in bow-legs and knock-knees.

The mechanics of knock-knee have been demonstrated* and in a former paper† I have shown the mechanics of bow-

* Bradford and Lovett. p. 640.
† Boston Med. and Surg. Jour. Sept. 26, 1895.

legs; therefore it is definitely known in what direction the bones will curve when they once begin to yield. At the earliest sign of deformity the legs should be manipulated every day. They should be grasped firmly with both hands and slightly bent in the opposite direction to the curve, several times at each sitting. Another important thing in the early cases is to keep the child off the feet as much as possible, and when supporting the weight of the body the legs should be firmly held by means of apparatus.

The apparatus may be described in very general language as a steel upright attached to the bottom of the shoe with a joint at the ankle but none at the knee.

In the case of knock-knee it extends to the top of the trochanter with a strap around the body and a leather pad buckled around the knee, which when gradually tightened pulls the knee outward until the leg becomes straight.

In bow-legs the steel upright is placed inside, with leather pads extending around the leg at the point of greatest curvature. These being gradually tightened pull the leg into the proper position.

For this mechanical treatment many people go for apparatus directly to the instrument shops, or are even sent there by the family physician. Here "braces" are applied and no other treatment even considered.

Doubtless many of you have seen cases fitted in this way, where, although the apparatus looks pretty, it is doing but very little good mechanically. Every case should be fitted by the surgeon, and a competent mechanic should do all the work under his immediate supervision. Then and then only will the best apparatus be constructed and the final results in the mechanical treatment of bow-legs and knock-knees be satisfactory to physician and parents.

In the cases where the bones are firm and unyielding, where it is manifestly too late for mechanical treatment, the appropriate operative measures should immediately be

taken. In the case of knock-knee an osteotomy as described by MacEwen is probably the best method to adopt. In the outward bowing of the legs an osteoclasis is sufficient. Although still objected to by many, I have had the best of results with this method in my own cases, and it seems as if the objections must be purely theoretical. In the outward curves of the fermur an osteotomy may be done or an open incision and removal of a small wedge. In the marked anterior bowings at the junction of the middle and lower third of the leg, it is better to do an open incision and remove a small wedge of bone.

In these deformities, whether in the early stages where mechanical treatment is sufficient, or in the later stages where surgical procedures are indicated, the prognosis is always excellent, so that the patient need *never* be dismissed with that comforting remark, "the child will outgrow it," but rather a vigorous treatment should be immediately instituted, so that the time will soon come when adult cases will no longer exist.

ARTICLE XVII.

THE SURGICAL TREATMENT OF SPASTIC PARALYSIS.

By WILLIAM N. BULLARD, M.D.
OF BOSTON.

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THE SURGICAL TREATMENT OF SPASTIC PARALYSIS.

Spastic Paralysis is that form of paralysis which is accompanied by an active tendency to tonic muscular spasm, or permanent contraction. In children this affection and its results are to be carefully distinguished from the condition found in anterior poliomyelitis and due to that affection. Spastic paralysis in children, when used to signify a particular disease or group of affections, is due to an intracranial lesion; anterior poliomyelitis is an affection of the spinal cord. Spastic paralysis may involve any or all of the limbs; it is most commonly of the hemiplegic or paraplegic type, but in children in a spastic hemiplegia the opposite lower extremity is almost invariably somewhat affected, though not to the degree of the limb on the affected side.

Spastic paralysis in children was first brought prominently to the notice of the profession by Mr. Little, and hence is has been known as Little's disease, this term being often limited more especially to the paraplegic form.

In the early days of orthopædics a few scattering operations were performed on cases of this affection, but the results experienced were not deemed satisfactory, and the generally accepted opinion of the profession was that on these patients operations were not advisable, because recontraction of the cut muscles was certain to occur and no permanent relief of the deformities could be hoped for.

Matters were in this position when Bradford first at the Boston Children's Hospital and elsewhere attempted relief of these patients by tenotomy.

He published the first account of a small series of cases in the Boston Medical and Surgical Journal in 1885. In spite, however, of this and of occasional operations performed by him, by Dr. A. T. Cabot and others, it was not until within the last five years that the exact value of the operation in these cases has been determined, and it has become in Boston the recognized treatment for certain conditions.

Operative procedure is advisable only in the more severe forms of spastic paralysis, where the deformity is considerable and disabling, and where it cannot be relieved by other forms of treatment, such as massage and electricity. The latter forms of treatment should, when practicable, be used thoroughly and patiently, and their inadequacy to produce by themselves the required results fully shown before we adopt operative measures. It is surprising, to those inexperienced in the matter, how much an apparently firmly contracted muscle can often be stretched with care and patience, and how much permanent effect can be produced by massage and electricity when properly applied, and when the applications are repeated regularly for weeks or months. We find, however, cases in which the slow method of procedure is difficult or impossible and also some in which it is unavailing. In these cases we the more readily resort to operation as the operation is comparatively simple and not to be considered dangerous. It is to be remembered, nevertheless, that in order to obtain good results the slow forms of procedure (massage and electricity) must be continued for a considerable time after the operation.

Before performing this operation it is very important that the surgeon should understand exactly what he may hope to accomplish by it.

In a successful operation the deformity should be essentially and permanently removed; the limb several years afterward should, when at rest, be in the position of a normal limb so far as the muscles or tendons operated upon are concerned. On the other hand, the operation neither relieves the tendency to spasm due to the original affection, nor does it in any way relieve the paresis. Indeed, so far as the strength of the limb is concerned, it takes away any support that may have existed due to the contraction or to the deformity thereby caused. The condition of the limb after a successful operation will, therefore, be that of a paretic or weakened limb of essentially normal shape. There will, moreover, exist in this limb a tendency to reflex spasm.

The correction of deformity is of more than æsthetic importance. It is the first step to relief or improvement, but it is only a step. Its value as a therapeutic measure consists in that it enables other remedies (massage and electricity) to be applied to better advantage. If the opportunity is not given for the use of these, operative measures are of but partial value.

The character of the operation is simple. It consists usually in dividing, wholly or partially, some portion of the tissue lying between the extreme attachment and origin of the muscle. This may be muscular tissue, tendon or aponeurosis. Personally, I believe, that except as an extraordinary measure, a pure myotomy should never be performed on account of the recontraction of the cicatricial tissues. Tenotomies or teno-myotomies are the only safe methods of division, counting divisons of aponeuroses or of tendons as essentially the same in this respect. After division the limb should be held for some time in a position of slight over-correction of the deformity.

Lengthening the tendon is only another method of accomplishing the same result.

SUMMARY.

Operative procedures — tenotomy and teno-myotomy — are of much value in cerebral spastic paralysis when their aim and scope are fully understood. They correct the deformity permanently and they place the limb in a favorable condition for treatment by other means; they are not themselves curative. Muscular tissue alone should not be divided. Where possible the tendons should be cut. Where this is not possible either muscle and tendon, or muscle and aponeurosis.

ARTICLE XVIII.

EXCISION AND ERASION OF THE KNEE.

By HAYWARD W. CUSHING, M.D.
OF BOSTON.

READ JUNE 9, 1896.

EXCISION AND ERASION OF THE KNEE.

I WILL first call attention to these diagrams which represent sections of the knee joint.

Fig. 2 shows a section in an antero-posterior vertical plane. The remainder are sections in a tranverse vertical plane. I wish to show:—(1) The relations and extent of the synovial membrane. (2) The position of the epiphyseal line. (3) Various types of tubercular disease. (Diseased areas colored black).

Especially:

Fig. 3. A circumscribed focus. Joint and synovia intact.

Figs. 4 and 5. The disease has extended into the joint. Epiphysis and synovia are involved.

Figs. 6, 7 and 8. Extensive disease with sequestrum formation and destruction of the joint.

Let us now consider the operation of "Excision."

First, the operation as it has been extensively described and taught. It is this: The knee joint is opened by a curved anterior incision, the crucial ligaments are cut, the articular ends of the femur and tibia are resected; care being taken not to injure the epiphyseal line. The patella may or may not be removed, the resected bones are nailed or wired together, the wound is closed with drainage, and an ultimate recovery with anchylosis is hoped for.

What is the result?

Usually, the formation of sinuses and long continued suppuration.

This is called an "excision" of the knee. It simply removes the joint.

What becomes of the synovia filled with tubercular products and the foci of osseous disease at or beyond the epiphyseal line? (Note extent and position of disease as shown in figures. Also its relation to synovia and epiphyseal line, especially in fig. 2.)

All is left behind untouched. The futility of such an operation as a radical one is at once apparent.

Contrast the above with the following operation:

The joint is opened and examined. Determine as far as possible the origin and extent of the disease. If the synovia is affected remove it with scissors and forceps. Follow it into every nook and pocket. See where it lies. Fig. 2. The bone is next attacked. How? With the sharp curette, chisel and gouge, not the saw. The diseased area only is removed. It is scooped out, not sawn off. The bones are united by periosteal silk or cat-gut sutures. The wound is closed without drainage. The dressing is sterile gauze fixed by plaster of Paris.

Results:

Primary union under one dressing in three weeks.

Firm bony union in eight or nine months.

The patient is well.

What is this operation called?

When the disease is limited, an erasion; when extensive, an arthrectomy.

What is its object?

To remove the disease thoroughly wherever it exists. It saves as far as possible the epiphyseal line. What does excision "so-called" do? It simply cuts out a joint.

Now what are the results of this method?

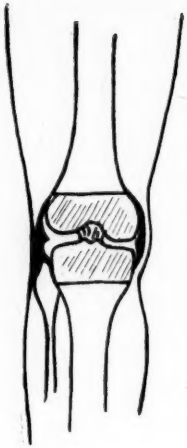

Fig. 1.

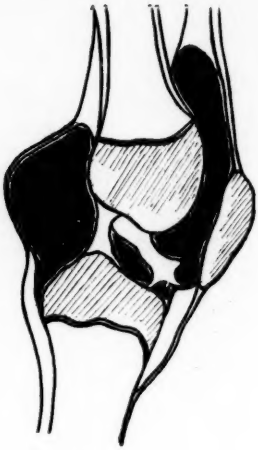

Fig. 2.

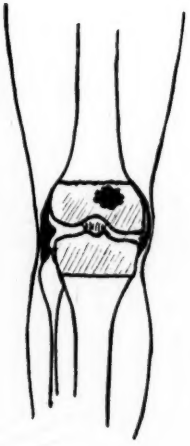

Fig. 3

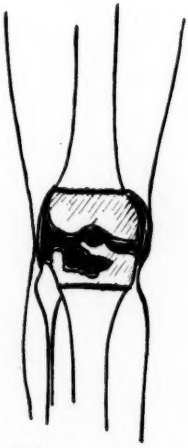

Fig. 4.

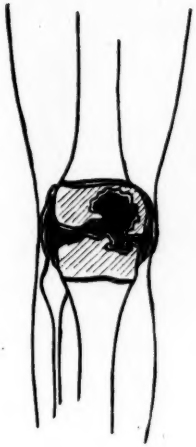

Fig 5

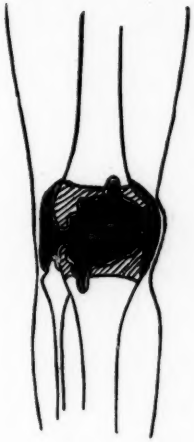

Fig 6.

Fig. 7.

Fig 8.

Here are the statistics; but I have time now for conclusions only. They are compiled from those cases alone whose condition I know to-day.

The mortality: It is nothing. No deaths. Eighty-six per cent. are well to-day, and fifty per cent. of the remainder have a fair chance for ultimate recovery.

The local condition: Recovery is in most cases without motion; bony anchylosis. In no case is there motion of any practical value.

Arrested developments: Atrophy and shortening are present in every case to a greater or less extent. The extreme is two and one-half inches. It is proportional to the age of the patient, the extent of the disease and the destruction of the epiphyseal line.

The leg is always straight or nearly so if the after treatment has been properly carried out. If you want straight legs don't omit fixation as long as there is a tendency to contraction. The contraction can become extreme if neglected. Hence don't make the mistake of omitting fixation as soon as your operation wound is healed or there is apparently bony union. Contraction can occur months afterward. Time is no criterion. We are continually correcting deformities at the Children's Hospital which have resulted from this cause.

To conclude: When you operate on a tuberculous knee operate so as to remove the disease. An erasion when limited; an arthrectomy when extensive. Reserve the typical excision operation to correct deformity from bony anchylosis.

If properly done the disease can be checked. Apparently cured. I say apparently, for no one can say when a tubercular patient is well.

There will result little or no motion. There will be more or less atrophy. There will be more or less shortening.

This result can occur even with marked coincident disease in other joints.

Operation is indicated: When the disease is unchecked by treatment; when it is extensive; when a patient cannot have proper conservative treatment; when the general condition demands it to save life; to correct deformity of the knee joint.

ARTICLE XIX.

THE TREATMENT OF CARIES OF THE ANKLE JOINT.

By CHARLES L. SCUDDER, M.D.
OF BOSTON.

READ JUNE 9, 1896.

THE TREATMENT OF CARIES OF THE ANKLE JOINT.

In the five minutes at my disposal I will present to you the facts regarding the operative treatment of caries of the ankle joint as accepted by the majority of Continental, English and American surgeons.

By caries of the ankle is understood a more or less chronic tubercular inflammation, starting in the astragalus, tibia or fibula and occasionally involving other bones of the tarsus —*i. e.*, a localized tuberculosis.

The great value of the treatment of caries of the joints by absolute immobilization and fixation is demonstrated beyond any doubt.

All cases of caries of the ankle should be first treated by the mechanical method unless operative interference is indicated by two things:

1. A failure of the general health.
2. Rapid progress in the local disease.

The moment that the non-operative or mechanical treatment is found inefficient, then an *operation* is demanded. Partial operations are of little value. Curetting and the burrdrill are contra-indicated. Complete excision of the diseased part (the entire bone being removed) is the very best operative procedure.

This is proved by the statistics of Culbertson, Hodges, Connor, Koslowski, Neuber and my own statistics of

eighteen cases reported from the records of the Children's Hospital, Boston, together with the evidence obtained from the records of private operators.

All operators advise complete excision of the diseased bone in *childhood*, because the duration of the disease is shortened, there is no mutilation of the foot, the general health improves immediately, there is no risk of sepsis, the danger of infection is removed, it is a safe operation, it will end the disease, and it will leave a serviceable limb.

In the case of adults partial operations are not valuable. If the expectant treatment fails amputation is necessitated.

Methods of excision.—The two lateral incisions are preferable—they expose the joint satisfactorily and no tendons are divided.

Note.—Two cases of caries of the ankle were exhibited which had been operated upon by excision of the astragalus four and five years previously. A perfectly useful ankle in each case exists to-day, with scarcely a perceptible limp.

Massachusetts Medical Society.

PROCEEDINGS OF THE COUNCILLORS.

October 2, 1895.

A Stated Meeting of the Councillors was held in the hall of the Medical Library Association, No. 19 Boylston Place, Boston, on Wednesday, October 2, 1895, at 11 o'clock, A.M.

The President, Dr. Frank K. Paddock, in the chair.

The following Councillors were present:

Berkshire.
T. C. Burnett,
F. K. Paddock.

Bristol North.
H. B. Baker,
F. A. Hubbard.

Bristol South.
G. DeN. Hough,
J. J. B. Vermyne.

Essex North.
M. D. Clarke,
C. E. Durant.

Essex South.
J. Allen,
D. Coggin,
A. H. Johnson,
C. E. Meader,
G. S. Osborne.

Hampshire.
H. B. Perry.

Middlesex East.
S. W. Abbott,
F. W. Graves.

Middlesex North.
B. R. Benner,
W. J. Sleeper,
C. A. Viles,
J. B. Wentworth.

Middlesex South.
Z. B. Adams,
D. E. Baker,
C. H. Cook,
J. G. Dearborn,
T. M. Durell,
W. Ela,
E. Farnham,
A. G. Griffin,
E. G. Hoitt,
R. P. Loring,
J. E. Marsh,
H. E. Marion,
G. N. P. Mead,
J. A. Mead,
J. T. G. Nichols,
E. H. Stevens,
L. R. Stone,
J. L. Sullivan,
J. O. Tilton,
H. P. Walcott,
A. C. Webber,
J. W. Willis,
A. Worcester.

Norfolk.
C. A. Cheever,
A. B. Coffin,
B. E. Cotting,
S. M. Crawford,
S. Crowell,
G. H. Francis,
J. S. Greene,
J. P. Maynard,
A. P. Perry,
M. V. Pierce,
O. F. Rogers,
I. W. Starbird,
G. B. Stevens,
C. F. Withington.

Norfolk South.
J. H. Gilbert,
J. F. Welch.

Plymouth.
W. G. Brown,
H. W. Dudley,
F. G. Wheatley.

Suffolk.
J. B. Ayer,
H. J. Barnes,
A. N. Blodgett,
E. H. Brigham,
F. H. Brown,
F. E. Bundy,
J. F. Bush,
B. F. Campbell,
J. R. Chadwick,
E. G. Cutler,
F. W. Draper,
C. F. Folsom,
E. J. Forster,
M. F. Gavin,
G. W. Gay,
A. R. Hahn,
W. H. H. Hastings,
W. C. Holyoke,
B. J. Jeffries,
F. I. Knight,
A. L. Mason,
F. Minot,
F. G. Morrill,
A. H. Nichols,
A. Post,
J. J. Putnam,
J. M. Putnam,
W. L. Richardson,
T. M. Rotch,
G. H. M. Rowe,
G. B. Shattuck,
J. B. Swift,
G. G. Tarbell,
H. F. Vickery,
J. C. White.
W. F. Whitney,
E. N. Whittier.

Worcester.
P. P. Comey,
W. Davis,
E. B. Harvey,
S. P. Holbrook,
J. O. Marble,
L. Wheeler.

Worcester North.
B. H. Hartwell,
F. H. Thompson.

Total, 107.

The record of the previous meeting was read and accepted.

The following were appointed Delegates to other State Medical Societies:

Vermont.—Drs. J. M. Fay, of Northampton; E. W. Dwight, of Boston.

New York.—Drs. D. March, Jr., of Winchester; N. P. Wood, of Northfield.

New York State Medical Association.—Drs. F. I. Proctor, of Boston; W. S. Robinson, of Taunton.

In accordance with the recommendation of the Committee on Membership and Finances, it was voted that the following be allowed to resign:

William T. Browne, of Norwich, Conn.
Anson W. Penniman, of London, England.

Also, that the following be allowed to retire:

Charles Jordan, of Wakefield.

Also, that the following be restored to Fellowship:

Joseph Boland Sayles, of West Newton.
Charles Herbert Williams, of Boston.

Also that the following be dropped for delinquency in assessment dues:

Samuel C. Thayer, of Hyde Park.

Adjourned at 12.15 P.M.

FRANCIS W. GOSS,
Recording Secretary.

FEBRUARY 5, 1896.

A STATED MEETING of the Councillors was held in the hall of the Medical Library Association, No. 19 Boylston Place, Boston, on Wednesday, February 6, 1896, at 11 o'clock A.M.

The President, Dr. FRANK K. PADDOCK, in the chair.

The following Councillors were present:

Berkshire.
J. F. A. Adams,
T. C. Burnett,
F. K. Paddock.

Bristol South.
G. DeN. Hough,
C. D. Prescott,
J. J. B. Vermyne.

Essex North.
M. D. Clarke,
C. P. Morrill.

Essex South.
D. Coggin,
J. W. Goodell,
C. W. Haddock,
T. Kittredge,
G. S. Osborne.

Middlesex East.
S. W. Abbott,
F. W. Graves,
J. M. Harlow.

Middlesex North.
H. B. Howard,
W. A. Johnson,
W. J. Sleeper,
C. A. Viles,
J. B. Wentworth.

Middlesex South.
Z. B. Adams,
D. E. Baker,
C. H. Cook,
E. Cowles,
W. Ela,
E. Farnham,
A. G. Griffin,
E. D. Hooker,
R. P. Loring,
J. E. Marsh,
H. E. Marion,
G. N. P. Mead,
J. A. Mead,
J. T. G. Nichols,
A. L. Norris,
E. H. Stevens,
L. R. Stone,
J. O. Tilton,
G. E. Titcomb,
H. P. Walcott,
J. W. Willis,
A. Worcester,
M. Wyman.

Norfolk.
E. H. Baxter,
A. W. Blair,
C. A. Cheever,
A. B. Coffin,
B. E. Cotting,
S. M. Crawford,
S. Crowell,
G. H. Francis,
E. B. Frye,
J. S. Greene,
W. Ingalls,
J. Kittredge,
W. B. Lancaster,
J. P. Maynard,
A. P. Perry,
M. V. Pierce,
O. F. Rogers,

H. R. Stedman,
E. T. Twitchell,
H. W. White,
C. F. Withington.

Norfolk South.
J. H. Gilbert,
J. F. Welch.

Plymouth.
J. B. Brewster,
W. G. Brown,
H. W. Dudley,
A. E. Paine,
F. G. Wheatley.

Suffolk.
J. B. Ayer,
A. N. Blodgett,
E. H. Brigham,
F. H. Brown,
E. M. Buckingham,
W. N. Bullard,
F. E. Bundy,
J. F. Bush,
B. F. Campbell,
J. R. Chadwick,
D. W. Cheever,
E. G. Cutler,
F. W. Draper,
T. W. Fisher,
R. H. Fitz,
C. F. Folsom,
E. J. Forster,
G. W. Gay,
C. M. Green,
A. R. Hahn,
W. H. H. Hastings,
W. C. Holyoke,
J. Homans,
B. J. Jeffries,
G. F. Jelly,
F. I. Knight,
J. H. McCollom,
J. J. Minot,
A. B. Morong,
A. H. Nichols,
J. M. Putnam,
W. L. Richardson,
T. M. Rotch,
F. C. Shattuck,
G. B. Shattuck,
A. D. Sinclair,
A. M. Sumner,
C. W. Swan,
G. G. Tarbell,
H. F. Vickery,
J. C. Warren,
J. C. White,
W. F. Whitney
E. N. Whittier.

Worcester.
W. Davis,
G. E. Francis,
T. H. Gage,
E. B. Harvey,
S. P. Holbrook,
J. O. Marble,
E. R. Wheeler,
L. Wheeler.

Worcester North.
E. J. Cutter,
B. H. Hartwell,
F. H. Thompson.
Total, 127.

The record of the previous meeting was read and accepted.

The following were appointed Delegates to other State Medical Societies:

Maine.—Drs. M. D. Clarke, of Haverhill; J. F. Young, of Newburyport.

New Hampshire.—Drs. F. B. Chapman, of Middleton; A. B. Chase, of Lynn.

Rhode Island.—Drs. H. L. Smith, of Boston; A. J. Abbe, of Fall River.

Connecticut.—Drs. C. H. Calkins, of Springfield; W. Davis, of Worcester.

New Jersey.—Drs. L. C. Swift, of Pittsfield; L. G. Chandler, of Townsend.

The following Committee was appointed:

To Audit the Treasurer's Accounts.—Drs. Walter Ela, J. B. Ayer.

The Committee on Membership and Finances reported through Dr. Draper. In accordance with their recommendation it was voted that the following be allowed to resign:

Gardner Cox, of Holyoke.
Joseph W. Warren, of Bryn Mawr, Pa.

Also, that the following be allowed to retire:

Charles Blodgett, of Holyoke.
George D. Colony, of Fitchburg.
Horace M. Holmes, of Adams.

In accordance with the request of the Board of Supervising Censors the following amendments to the By-Laws (edition of 1894) were passed and referred to the Society for concurrent vote:

By Law XIII., p. 13, line 23, add, "The term of service of all the Boards of Censors shall begin on the day preceding the annual meeting of the State Society."

By-Law XIX., p. 15, lines 19 and 20, omit the words "they shall appoint the time and place of the annual meeting of the Supervisors."

By-Law XX., p. 16, line 6, change the word "ten" to "five," and make the necessary changes in, and additions to, lines 8–10, so that they shall read:

"For the transaction of business five Supervisors shall constitute a quorum.

"They shall hold an annual meeting at the same date and place as that of the Council; and may hold other meetings at such places and times as they may agree to appoint. The fares of Supervisors present at their meetings shall be paid from the treasury of the State Society."

Page 17, strike out lines 10–29, and substitute the following:

"The Censors of all the several District Societies shall meet for the examination of candidates at 2 P.M. on the Thursday next preceding the annual meeting of the Society (Digest XIX.), and at the same hour on the third Thursday of September, and of December; and at such other times as the Councillors may direct.

"The Censors for the Suffolk District Society shall officiate for that District and for the Society at large. They shall meet in Boston, and may advertise their meetings in such manner as the Board may determine; but they shall not examine any candidate who is already a resident, or in practice, in any District except their own.

"The Censors of other medical Districts shall hold their meetings for the examination of candidates residing in their respective Districts, and none other, but shall not advertise unless the District Societies, at their own expense, direct it to be done (II., XIII.)."

On nomination by the President it was voted, that Dr. H. P. Walcott be appointed a member of the Society's Committee to consider the condition of instruction in physiology and hygiene in the public schools of the State, in place of Dr. Johnson, resigned.

Dr. Jelly read the petition and draft of an act, presented by the Boston Medico-Psychological Society to the Massachusetts Legislature, and moved the passage of the following:

Voted, That the Committee on State and National Legislation be instructed to consider the question of a division of the State Board of Lunacy and Charity, for the purpose of establishing a Board of Commissioners in Lunacy; and that the Committee be empowered to act at its discretion, by petition to the State Legislature, or otherwise, in aid of a petition to the same effect, already presented to the Legislature by the Boston Medico-Psychological Society.

After discussion, the resolution was adopted.

Dr. Harvey offered the following, which was adopted:

Whereas, It has come to the knowledge of the Councillors of the Massachusetts Medical Society that an attempt is being made at the present time, through legislative action, to compel the use of the so-called Keeley cure in the Massachusetts Hospital for Dipsomaniacs and Inebriates, therefore,

Resolved, That the Councillors of the said Society assembled in convention on this, the fifth day of February, 1896, most earnestly remonstrate against such proposed perversion of medical science, and pernicious interference with the management of the said hospital.

Voted, That the Secretary transmit a copy of this vote to the Trustees of the Hospital for Dipsomaniacs.

Adjourned at 12.20 P.M.

FRANCIS W. GOSS,
Recording Secretary.

May 22, 1896.

A Special Meeting of the Councillors was held in the hall of the Medical Library Association, No. 19 Boylston Place, Boston, on Friday, May 22, 1896, at 12 o'clock, noon.

The President, Dr. Frank K. Paddock, in the chair.

The following Councillors were present:

Berkshire.
F. K. Paddock.

Bristol North.
E. F. Galligan.

Essex South.
J. W. Goodell,
T. J. Hayes,
G. E. Macarthy.

Middlesex East.
S. W. Abbott.

Middlesex North.
B. R. Benner.

Middlesex South.
D. E. Baker,
R. A. Blood,
C. H. Cook,
E. Farnham,
A. G. Griffin,
E. D. Hooker,
R. P. Loring,
J. E. Marsh,
H. E. Marion,
G. N. P. Mead,
J. T. G. Nichols,
A. L. Norris,
L. R. Stone,
J. O. Tilton,
H. P. Walcott,
A. C. Webber,
J. W. Willis,
M. Wyman.

Norfolk.
A. W. Blair,
B. E. Cotting,
S. M. Crawford,
G. H. Francis,
T. Garceau,
J. S. Greene,
W. B. Lancaster,
J. P. Maynard,
A. P. Perry,
O. F. Rogers,
H. W. White.

Norfolk South.
J. H. Gilbert,
J. A. Gordon,
J. F. Welch.

Plymouth.
W. G. Brown,
H. W. Dudley.

Suffolk.
J. B. Ayer,
A. N. Blodgett,
E. H. Brigham,
F. H. Brown,
J. F. Bush,
A. T. Cabot,
D. W. Cheever,
F. W. Draper,
T. W. Fisher,
C. F. Folsom,
W. W. Gannett,
G. W. Gay,
C. M. Green,
A. R. Hahn,
W. H. H. Hastings,
W. C. Holyoke,
J. Homans,
A. L. Mason,
A. Post,
J. J. Putnam,
J. M. Putnam,
W. L. Richardson,
T. M. Rotch,
G. H. M. Rowe,
F. C. Shattuck,
A. D. Sinclair,
A. M. Sumner,
G. G. Tarbell,
H. F. Vickery,
J. C. Warren,
J. C. White.

Worcester.
P. P. Comey,
W. Davis,
T. H. Gage,
E. B. Harvey,
S. P. Holbrook,
A. Wood.

Worcester North.
E. J. Cutter,
F. H. Thompson.

Total, 80.

The record of the previous meeting was read and accepted.

The President announced that this special meeting had been called to elect a Treasurer of the Society to succeed the late Treasurer, Dr. Edward J. Forster, whose death occurred suddenly and unexpectedly one week ago to-day. In well-chosen words the President spoke of the life and work of Dr. Forster.

Voted, That the Nominating Committee chosen by the District Societies a year ago be a Committee to present a name as a candidate for the office of Treasurer.

The Nominating Committee unanimously reported the name of Dr. Edward M. Buckingham, of Boston, as candidate for the office of Treasurer of the Society, and the same was elected by ballot to fill the unexpired term of the late Treasurer.

Voted, That the Committee on Membership and Finances be authorized and instructed to receive the Society's funds and papers from the estate of the late Treasurer, to audit the same, and to transfer them to the Treasurer elect, receiving from him the usual bond with sureties.

Adjourned at 12.45 P.M.

FRANCIS W. GOSS,
Recording Secretary.

JUNE 9, 1896.

THE ANNUAL MEETING of the Councillors was held in the hall of the Medical Library Association, No. 19 Boylston Place, Boston, on Tuesday, June 9, 1896, at 7 o'clock, P.M.

The President, Dr. FRANK K. PADDOCK, in the chair.

The following Councillors were present:

Barnstable.
B. D. Gifford.

Berkshire.
O. J. Brown,
W. W. Leavitt,
F. K. Paddock.

Bristol North.
H. B. Baker,
E. F. Galligan.

Bristol South.
J. H. Gifford,
C. D. Prescott,
J. J. B. Vermyne.

Essex North.
F. W. Anthony,
G. C. Clement,
J. A. Fitz-Hugh.

Essex South.
C. A. Ahearne,
J. Allen,
F. S. Atwood,
G. M. Frost,
W. E. Holbrook,
C. W. Page.

Hampden.
C. W. Jackson.

Hampshire.
H. B. Perry.

Middlesex East.
S. W. Abbott,
F. W. Graves.

Middlesex North.
C. B. Sanders.

Middlesex South.
D. E. Baker,
J. G. Dearborn,
E. G. Hoitt,
E. D. Hooker,
R. P. Loring,
J. E. Marsh,
H. E. Marion,
G. N. P. Mead,
J. T. G. Nichols,
A. L. Norris,
G. C. Pierce,
L. R. Stone,
J. L. Sullivan,
H. C. White,
J. W. Willis,
M. Wyman.

Norfolk.
A. B. Coffin,
S. M. Crawford,
S. Crowell,
G. H. Francis,
J. S. Greene,
W. Ingalls,
W. B. Lancaster,
J. P. Maynard,
M. V. Pierce,
O. F. Rogers,
H. R. Stedman,
G. B. Stevens,
E. T. Twitchell,
H. W. White,
C. F. Withington.

Norfolk South.
J. H. Gilbert,
J. A. Gordon.

Plymouth.
H. W. Dudley,
A. E. Paine,
F. G. Wheatley.

Suffolk.
J. B. Ayer,
E. M. Buckingham,
J. F. Bush,
A. T. Cabot,
B. F. Campbell,
H. Derby,
F. W. Draper,
T. W. Fisher,
R. H. Fitz,
C. F. Folsom,
W. W. Gannett,
G. W. Gay,
C. M. Green,
A. R. Hahn,
W. H. H. Hastings,
W. C. Holyoke,
J. Homans,
F. I. Knight,
A. L. Mason,
J. H. McCollom,
A. B. Morong,
A. H. Nichols,
A. Post,
J. J. Putnam,
J. M. Putnam,
W. L. Richardson,
T. M. Rotch,
G. H. M. Rowe,
J. B. Swift,
G. G. Tarbell,
H. F. Vickery,
J. C. White.

Worcester.
P. P. Comey,
W. Davis,
G. E. Francis,
T. H. Gage,
E. B. Harvey,
S. P. Holbrook,
J. O. Marble,
E. W. Norwood,
E. L. Sawyer,
E. R. Wheeler,
A. Wood.

Worcester North.
L. G. Chandler,
F. H. Thompson.

Total, 104.

The record of the previous meeting was read and accepted.

The Secretary read the names of new and of deceased Fellows.

In consequence of the recent death of Dr. Forster, no Treasurer's report for the financial year ending April 15, 1896, was at hand, and no papers were available for the Auditing Committee. It was therefore voted, that the Auditing Committee report in print in the Society's Proceedings, and also to the Councillors at their next meeting.

The Committee on Membership and Finances reported through Dr. Draper and recommended that $2000,00 of the surplus in the treasury be distributed among the District Societies.

Voted, That the recommendation of the Committee be adopted.

In accordance with the recommendation of the same Committee it was voted, that the following be allowed to resign:

Horace Fox, of Philadelphia, Pa.
Richard P. Francis, of Montclair, N. J.
Albert R. Moulton, of Philadelphia, Pa.

Also, that the following be allowed to retire:

John A. Lamson, of Boston.
Alonzo C. Webber, of Cambridge.

The Committee on Publications presented their report.

The Committee on State and National Legislation presented the following, which was adopted:

Whereas, The Councillors of the Massachusetts Medical Society have learned that a bill has been introduced into the Congress of the United States for the restriction of biological research in the District of Columbia,

Resolved, That a copy of the resolution adopted by the Massachusetts Medical Society on June 8, 1892, in response to a communication from the Massachusetts Society for the Prevention of Cruelty to Animals, be forwarded to the Senators and Repre-

sentatives of this State as an expression of the opinion of the Massachusetts Medical Society with regard to legislation on this subject, either in Massachusetts or in the District of Columbia.

The Committee appointed to examine and report upon the Digest, also to consider what changes, if any, in the By-Laws are necessary, that they may conform to the existing statutes relating to the Society, reported through Dr. Harvey, that a compilation of the statutes of the Commonwealth now in force relating to the Society has been drafted by legal council; also, a revision of the By-Laws, that they may conform more closely to the statutes in force.

The Committee asked for permission to print, and distribute to the Councillors, copies of the said compilation and By-Law revision, that they may be considered and acted on intelligently at the next meeting of the Councillors; said printing and distribution to be done at the expense of the Society.

Voted, To grant the request of the Committee and to adopt their recommendation.

The Librarian, Dr. Brigham, presented his report.

The Committee on Nominations reported a list of candidates for the offices of the Society for the ensuing year, and the same were elected by ballot:

President . .	Dr. HENRY P. WALCOTT, of Cambridge.
Vice-President .	Dr. ALBERT WOOD, of Worcester.
Treasurer . .	Dr. EDWARD M. BUCKINGHAM, of Boston.
Corresponding Sec'y	Dr. CHARLES W. SWAN, of Boston.
Recording Secretary	Dr. FRANCIS W. GOSS, of Roxbury.
Librarian . .	Dr. EDWIN H. BRIGHAM, of Boston.

Dr. Z. B. ADAMS, of Framingham, was chosen Orator for the Annual Meeting of the Society in 1897.

Voted, That the next Annual Meeting of the Society be held in Boston, on the second Wednesday in June, 1897.

Voted, That the Annual Meeting of the Supervisors be held this evening, on adjournment of the Councillors' meeting.

On nomination by the President, the following Standing Committees were appointed:

Of Arrangements.

A. K. Stone, M. V. Pierce, J. E. Goldthwait,
J. G. Mumford, P. Thorndike, M. Storer.

On Publications.

B. E. Cotting, O. F. Wadsworth, G. B. Shattuck.

On Membership and Finances.

F. W. Draper, J. Stedman, E. G. Cutler,
L. R. Stone, F. W. Goss.

To Procure Scientific Papers.

H. P. Bowditch, F. H. Zabriskie, H. L. Burrell,
F. W. Chapin, C. W. Townsend.

On Ethics and Discipline.

G. E. Francis, F. C. Shattuck, C. G. Carleton,
E. Cowles, J. F. A. Adams.

On Medical Diplomas.

H. E. Marion, E. N. Whittier, O. F. Rogers.

On State and National Legislation.

H. P. Walcott, H. P. Bowditch, T. H. Gage,
S. D. Presbrey, E. B. Harvey.

Dr. D. E. Baker presented a memorial to induce the Legislature to pass an act making it the duty and function of the State to furnish the supply of vaccine lymph.

Voted, That the matter be referred to the Committee on State and National Legislation, to report at the next meeting.

Adjourned at 8.20 P.M.

FRANCIS W. GOSS,
Recording Secretary.

Massachusetts Medical Society.

PROCEEDINGS OF THE SOCIETY.

ADJOURNED MEETING.

OCTOBER 2, 1895.

THE Society met, pursuant to adjournment, at 1 o'clock P.M., on Wednesday, October 2, 1895, in the hall of the Medical Library Association, No. 19 Boylston Place, Boston.

The President, Dr. FRANK K. PADDOCK, in the chair.

Voted, That the Society concur in the amendments to By-Law XVII., passed by the Councillors, February 6, 1895, so that the By-Law shall read:

XVII. Councillors shall be chosen by the District Societies, as directed in By-Law XIII.; each Society choosing, from among the Fellows residing within its District, in the proportion of one Councillor to every twelve Fellows, or a majority fraction thereof.

Adjourned.

FRANCIS W. GOSS,
Recording Secretary.

ANNUAL MEETING.

FIRST DAY.

JUNE 9, 1896.

THE Shattuck Lecture was given by Dr. WILLIAM W. KEEN, of Philadelphia, at 1 o'clock P.M., Tuesday, June 9, 1896, in the building of the Massachusetts Charitable Mechanic Association, Boston.

Sectional meetings were held at 2.30 o'clock P.M.

The sections were organized and papers were presented as follows:

SECTION IN MEDICINE.

Dr. A. L. Mason, of Boston . . . . . Chairman.
Dr. G. G. Sears, of Boston . . . . . Secretary.

Diphtheria Antitoxine.—By Dr. J. H. McCollom, of Boston.

Treatment of Diseases, other than Diphtheria, by Antitoxines.—By Dr. Henry Jackson, of Boston. Discussion by Dr. H. C. Ernst, of Boston.

Internal Secretion of Glands.—By Dr. W. T. Porter, of Boston.

The Clinical Use of the Preparations from the Thyroid Gland, Pituitary Body, Suprarenal Capsules and Bone Marrow.—By Dr. R. C. Cabot, of Boston.

SECTION IN SURGERY.

Dr. John Homans, of Boston . . . . . Chairman.
Dr. J. C. Munro, of Boston . . . . . Secretary.

Operative Treatment of Congenital Dislocation of the Hip.—By Dr. E. H. Bradford, of Boston.

Excision and Erasion of the Knee.—By Dr. H. W. Cushing, of Boston.

The Treatment of Bow-Legs and Knock-Knees.—By Dr. F. E. Peckham, of Providence, R. I.

Ultimate Results of Excision of the Hip.—By Dr. R. W. Lovett, of Boston.

Treatment of Lateral Curvature of the Spine.—By Dr. E. G. Brackett, of Boston.

Measurements in Lateral Curvature of the Spine.—By Dr. G. W. Fitz, of Cambridge.

Operative Treatment of Infantile Paralysis.—By Dr. J. E. Goldthwait, of Boston.

Treatment of Club-foot.—By Dr. Augustus Thorndike, of Boston.

Pathology of Spinal Caries.—By Dr. E. H. Nichols, of Boston.

The Treatment of Caries of the Ankle-Joint.—By Dr. C. L. Scudder, of Boston.

SURGICAL TREATMENT OF SPASTIC PARALYSIS.—By Dr. W. N. Bullard of Boston.

TREATMENT OF COLD ABSCESSES.—By Dr. Homer Gage, of Worcester.

DIAGNOSIS OF HIP DISEASE.—By Dr. E. G. Brackett, of Boston.

DIAGNOSIS OF POTT'S DISEASE.—By Dr. R. W. Lovett, of Boston.

TREATMENT OF FLAT-FOOT.—By Dr. J. S. Stone, of Boston.

METHODS OF TREATMENT, AND PROGRESS IN ORTHOPEDIC SURGERY (ILLUSTRATED WITH THE STEREOPTICON).—By Dr. E. H. Bradford, of Boston.

FRANCIS W. GOSS,
Recording Secretary.

SECOND DAY.

JUNE 10, 1896.

THE Society met in Mechanic Building, Boston, on Wednesday, June 10, 1896, at 9 o'clock, A.M., for the exercises of the one hundred and fifteenth Anniversary.

The President, Dr. FRANK K. PADDOCK, in the chair.

The records of the last annual meeting and of the subsequent adjourned meeting were read and accepted.

The Secretary presented the names of Fellows reported admitted since the last annual meeting, and of Fellows whose deaths had been recorded.

Admissions reported since June 11, 1895.

1895	Abbe, Frederick Randolph	Dorchester.
1895	Ash, John Henry	Quincy.
1896	Averill, George Goodwin	Boston.
1896	Ayer, Thomas Herbert	Worcester.
1895	Baldwin, Herman Trost	Boston.
1896	Barney, Charles Norton	Boston.
1896	Bean, Charles Pierce	Boston.
1896	Bernauer, Emil Constantine	Dorchester.

1896	Blossom, Anne Mooers	North Adams.
1896	Boyd, James Van Wagner	Springfield.
1895	Boynton, Edwin Dana	Worcester.
1895	Boynton, Joseph Jackson	South Framingham.
1895	Bradford, Cary Carpenter	Southbridge.
1896	Branch, Charles Franklin	Amherst.
1895	Brewster, Mary Jones	Brookline.
1896	Brousseau, William Gilbert	Boston.
1895	Bruce, Daniel Angus	Atlantic.
1896	Bruce, John Angus	Everett.
1896	Brunelle, Pierre	Lowell.
1896	Bullock, George Dexter	Weymouth.
1895	Burton, James	Gilbertville.
1895	Byers, David Walter	Reading.
1895	Byrne, Charles Armstrong	Hatfield.
1895	Camp, Mary Augusta	Brookline.
1896	Carleton, Dudley	Springfield.
1895	Chadwick, Henry Dexter	Boston.
1895	Chamberlain, William Eugene	Rutland.
1895	Child, Edward Moses	Florence.
1895	Church, Charles Albert	Millbury.
1896	Church, Mary Violet	Roxbury.
1895	Chute, Arthur Lambert	Minneapolis, Minn.
1895	Cleaves, Frederick Henry	Concord.
1895	Cobb, Carolus Melville	Lynn.
1895	Codman, Ernest Amory	Boston.
1896	Coggswell, William	Boston.
1895	Cooke, George Andrews	Miller's Falls.
1896	Cronin, Henry William	Millbury.
1895	Couillard, Pierre Leonard	Manchaug.
1896	Daly, William Joseph	Boston.
1895	Darling, Charles Balfour	Boston.
1895	Davis, Bessie Delano	Cambridgeport.
1895	Dennis, James Henry	Worcester.
1895	Denny, Frances Parkman	Brookline.
1895	Dever, Charles Edward	Lynn.
1896	Dewey, David Robert	North Adams.
1896	Dodd, Isaac Spencer Fanning	Pittsfield.
1896	Dolliver, George Carroll	Boston.
1895	Donahue, William Francis	East Cambridge.
1895	Drew, Fred	Boston.
1895	Drew, Maria Emma	Atlantic.
1895	Engelmann, George Julius	Boston.
1895	Farnham, John Marshall Willoughby	Worcester.
1896	Farrell, George Louis	Malden.
1895	Fernald, Walter Elmore	Waverly.
1895	Fosgate, Elmer Gilman	Ashburnham.

1896	French, John Innis	Boston.
1896	Frissell, Edward Merle	Webster.
1895	Gates, Ernest A	Springfield.
1895	Grant, James Henry	Lynn.
1896	Gray, Elizabeth Taylor	Roxbury.
1896	Guild, Thomas Ezra	Mattapan.
1895	Hanley, Francis Joseph	Whitman.
1895	Hanley, John Joseph	Boston.
1895	Harkins, Cornelius Patrick	Boston.
1895	Harriman, Frank Whitman	Boston.
1895	Harris, Arthur Eugene	Lynn.
1896	Hart, George Fred	Webster.
1895	Hedenberg, James	Medford.
1896	Hill, George Hillard	Worcester.
1895	Holden, George Walter	North Brookfield.
1896	Holland, James William	Westfield.
1896	Holmes, Harry Clinton	Cambridge.
1895	Holmes, May Salona	Worcester.
1895	Hopkins, Frederick Eugene	Springfield.
1895	Hudnut, Frank Parker	Needham.
1896	Hughes, Laura Ann Clesphos	Boston.
1895	Hutchinson, Cheesman Palmer	Holliston.
1895	Ingham, Lucius Thomas	West Stockbridge.
1896	Kelleher, Patrick Francis	Boston.
1895	Kennard, Henry Delano	Lynn.
1894	Lake, Charles Norton	Detroit, Mich.
1895	Leach, Albert Clinton	Orange.
1895	Leavitt, Dudley	Pittsfield.
1895	Little, Abby Noyes	Newbury.
1895	Lougee, Frank Taylor	Lynn.
1896	Lyons, Joseph Benedict	Charlestown.
1896	McAdams, James Philip	Lowell.
1896	Macdonald, Alexander Ambrose	Roxbury.
1896	McIntosh, Herbert	Boston.
1895	McKoan, John William	Worcester.
1895	McLaughlin, Henry Valentine	Brookline.
1895	McLennan, Roderick	Quincy.
1896	McNamara, Eugene Thomas	Boston.
1896	Mahoney, George Clifton	Somerville.
1895	Marsh, Arthur White	Boston.
1896	Merrill, Arthur Ellsworth	Somerville.
1896	Metcalf, Ben Hicks	Boston.
1895	Meyer, Adolf	Worcester.
1895	Miller, Lester Colwell	Worcester.
1896	Minsall, Arthur Gladstone	Northampton.
1895	Moore, John Patrick	Worcester.
1896	Morse, Frank Leander	Boston.

1896	Mosher, Frank Orson	Boston.
1896	Muttart, George Morley	East Boston.
1895	Nason, Osman Cleander Baker	Reading.
1895	Olin, Francis Henry	Southbridge.
1895	Packard, Edward Albert	Worcester.
1896	Painter, Charles Fairbank	Boston.
1896	Patch, Annie Sophia Kenney	Boston.
1895	Paulsell, Mary	Roxbury.
1896	Pearl, Frederick Warren	Boston.
1895	Pierce, Appleton Howe	Worcester.
1895	Plummer, Paul	Melrose.
1895	Porter, William Townsend	Boston.
1896	Potter, Francis Mason	Boston.
1895	Prouty, Albert Henry	North Brookfield.
1896	Rand, Richard Baxter	North Abington.
1896	Rawson, George Wallace	Amherst.
1896	Rice, Walter Henry	Brookline.
1895	Roberts, Linneus Alton	Dorchester.
1895	Royal, Herbert Benjamin	Harvard.
1895	Ryan, John Laurence	Worcester.
1895	St. Clair, Austin Emery	So. Framingham.
1896	Sanderson, Mary	Worcester.
1896	Savage, John James	Lowell.
1896	Sawyer, Frank Wade	Everett.
1896	Scales, Robert Bass	Dorchester.
1895	Scannell, Michael Edward	Worcester.
1895	Selva, Julius	Boston.
1895	Shattuck, Albert Milo	Groton.
1895	Sheahan, Joseph Maurice	Quincy.
1896	Silva, Francis Pierce	Charlestown.
1895	Smith, Fred Stevens	North Andover.
1896	Sosnoski, Philip	Roxbury.
1895	Stanley, Josiah Murch	Northboro.
1896	Steele, John McClary	Worcester.
1896	Stiles, Herbert Kendall	Roslindale.
1896	Stone, Moses Cornelius	Dorchester.
1895	Stowell, Joab, Jr.,	North Amherst.
1896	Sturgis, Walter Horatio Wakeman	Hull.
1895	Sweet, Frederick Benoni	Springfield.
1895	Thomas, George Henry	Roxbury.
1896	Thompson, John Joseph	Webster.
1895	Tobin, James Henry	Pittsfield.
1895	Tucker, Willis Leroy	Hinsdale.
1895	Watkins, Royal Phillips	Worcester.
1896	Watson, Walter Linwood	Weston.
1895	Wattles-Faunce, Mary Ann	Newtonville.
1895	Webber, Horace Green	Wilbraham.

1896	White, Franklin Warren	. .	Boston.
1896	White, Leonard Darling	. .	Uxbridge.
1895	Wylie, Eugene Cushman	. .	Dorchester.
1895	Yoosuf, Abraham Kevork	. .	Worcester.
		Total,	153.

List of Deceased Fellows.

Admitted.	Name.	Residence.	Date of Death.	Age.
1865	Adams, Benjamin Franklin Dunkin	Colorado Sp'gs, Col.	Oct. 28, 1895	56
1855	Barns, John	Milford.	Sept. 27, 1895	78
1886	Cochrane, John McGregor	Somerville.	Aug. 6, 1895	36
1858	Cogswell, George Badger	North Easton.	March 6, 1896	61
1872	Copeland, George Walter	Middleborough.	April 30, 1896	50
1847	Cushing, Benjamin	Dorchester	Oct. 16, 1895	73
1874	Cushman, Thaddeus Thompson	Randolph	Feb. 6, 1896	76
1848	Dickerman, Lemuel	Foxborough	Aug. 14, 1895	69
1879	Dunbar, Eugene Fillmore	Roxbury	Feb. 20, 1896	44
1866	Fish, Dyer Ball Nelson	Amherst	Oct. 28, 1895	57
1868	Forster, Edward Jacob	Boston.	May 15, 1896	49
1895	Harriman, Frank Whitman	Boston.	Jan. 7, 1896	21
1880	Harmon, Samuel Tappan	Boston.	Feb. 7, 1896	37
1869	Hastings, Joseph Wilcox	Warren.	Sept. 23, 1895	61
1853	Hodges, Richard Manning	Boston.	Feb. 9, 1896	68
1850	Jewett, Henry Alfred	Northborough.	Aug. 23, 1895	75
1865	Johnson, Amos Howe	Salem.	May 12, 1896	64
1884	Kelley, George Wallace	Passadena, Cal.	May 20, 1896	39
1886	McGlynn, Edward	Roxbury	July 26, 1895	32
1882	Mayberry, Edwin	E. Weymouth.	July 18, 1895	68
1845	Newell, Robert Wingate	Boston.	April 9, 1896	81
1853	Randall, George Henry	No. Rehoboth.	Jan. 18, 1896	70
1877	Rich, Joshua Bartlett	Worcester.	Feb. 25, 1896	51
1876	Robinson, Walter Scott	Taunton.	June 4, 1896	57
1848	Slade, Daniel Denison	Chestnut Hill.	Feb. 11, 1896	72
1856	Soulé, Horatio Sprague	Winthrop.	Oct. 7, 1895	72
1853	Stetson, John	West Harwich.	Feb. 19, 1896	81
1883	Stevens, Frank Dana Switzer	Lynn.	Feb. 13, 1896	35
1843	Thomson, George Newton	Boston.	July 13, 1895	82
1859	Towle, Samuel Knapp.	Haverhill.	Aug. 16, 1895	65
1887	Tracy, Albert Francis	Westfield	July 18, 1895	32
1880	*Vernhuil, Aristide Auguste Stanislas	Paris, France.	June 12, 1895	72
1863	Ward, George Whitfield	Upton	Dec. 11, 1895	79
1846	Warren, Royal Sibley	Col. Sp'gs, Col.	Feb. 13, 1896	73
1884	Weil, Frank Edward	No. Andover.	Jan. 6, 1896	35
1869	Whitney, James Orne	Pawtucket, R.I.	Jan. 24, 1895	71
1865	Wigglesworth, Edward	Boston.	Jan. 23, 1896	55
1849	Williams, Henry Willard	Boston.	June 13, 1895	73
1878	Wyman, Samuel Edwin	Cambridge.	May 7, 1896	43

* Honorary. Total, 39.

Voted, That when the Society adjourns it be to 1 P.M., on the first Wednesday in October, 1896, at the place where the Coun-

cillors shall meet on that day, to act on amendments to the By-Laws and any other matters that may legally come before the Society.

The following papers were read:

THE PULMONARY INVALID IN COLORADO.—By Dr. C. E. Edson, of Roxbury.

THE TREATMENT OF PHTHISIS IN SANITARIA NEAR OUR HOMES.—By Dr. V. Y. Bowditch, of Boston. Discussion by Dr. F. I. Knight, of Boston.

THE TREATMENT OF TUBERCULOSIS BY THE INJECTION OF TUBERCULIN AND ITS DERIVATIVES.—By Dr. Alfred Worcester, of Waltham.

NUCLEINS AND NUCLEO-PROTEIDS IN THEIR RELATION TO INTERNAL SECRETION.—By R. H. Chittenden, Ph.D., of New Haven, Conn.

EXTRA-UTERINE PREGNANCY FROM THE STANDPOINT OF THE GENERAL PRACTITIONER.—By Dr. E. S. Boland, of South Boston.

ECTOPIC GESTATION.—By Dr. M. H. Richardson, of Boston.

The following delegates from other State Medical Societies were present:

Maine.—Drs. A. S. Thayer, Alfred King.

New Hampshire.—Dr. H. D. W. Carvelle.

Vermont.—Dr. J. H. Jackson.

Rhode Island.—Dr. F. L. Day.

New York.—Dr. J. H. Glass.

New York State Medical Association.—Drs. Robert Newman, F. H. Wiggin.

New Jersey.—Drs. S. A. Helfer, J. A. Exton.

Drs. Thayer, Newman, Wiggin and Exton presented the greetings of their respective Societies.

At 12 o'clock the Annual Discourse was delivered by Dr. HENRY P. BOWDITCH, of Boston.

Voted, That the thanks of the Society be presented to the Orator for his strong vindication of physiological science from the charge of cruelty.

At 1 P.M. the Annual Dinner was served to nine hundred and thirty Fellows and invited guests.

FRANCIS W. GOSS,
Recording Secretary.

AUDITING COMMITTEE'S REPORT.

The undersigned, a Committee duly appointed to audit the account to April 15, 1896, of the late Treasurer, Dr. E. J. FORSTER, find it correctly cast and vouched, and that there were on hand the securities called for and funds amounting to $6606.46.

WALTER ELA,
J. B. AYER, } *Committee.*

JULY 25, 1896.

Officers of the Massachusetts Medical Society.

1896—1897.

Chosen June 9, 1896.

HENRY P. WALCOTT, . . Cambridge, President.
ALBERT WOOD, ... Worcester, Vice-President.
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2. The Publications are sent only to those who have paid their assessments, and to such Honorary and Retired Members as may annually apply for them.

3. The annual assessment should be paid in advance (*i.e.* before the close of the Annual Meeting), either to the proper District Treasurer, or to the Treasurer of the Society, Dr. EDWARD M. BUCKINGHAM, 53 Worcester Street, Boston. Payments thus made increase the annual dividend to the District Societies. Checks should be made payable to the order of the Massachusetts Medical Society.

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7. The next Annual Meeting of the Society will be held in Boston, on the second Wednesday in June, 1897. Meetings of Sections on the preceding day.

FRANCIS W. GOSS,
Recording Secretary.

217 *Warren Street, Roxbury, Mass.*

Medical Communications

OF

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ARTICLE XX.

THE ANNUAL DISCOURSE.

AN EPOCH IN MEDICINE IN AN AGE OF DELUSION.

By ZABDIEL BOYLSTON ADAMS, M.D.
OF FRAMINGHAM.

DELIVERED JUNE 9, 1897.

NOTE.—At an Adjourned Meeting of the Massachusetts Medical Society, held Oct. 3, 1860, it was

Resolved, "That the Massachusetts Medical Society hereby declares that it does not consider itself as having endorsed or censured the opinions in former published Annual Discourses, nor will it hold itself responsible for any opinions or sentiments advanced in any future similar discourses."

Resolved, "That the Committee on Publications be directed to print a statement to that effect at the commencement of each Annual Discourse which may hereafter be published."

AN EPOCH IN MEDICINE IN AN AGE OF DELUSION.

Quis deus hanc, musæ, quis nobis extudit artem?
Unde nova ingressus hominum experientia cepit?

Mr. President and Fellows
of the Massachusetts Medical Society:

He is to be accounted most happy who can find the fitting word to speak before this Society to-day, for we have reached, as I conceive, the grandest epoch in the history of medicine; an epoch in which Massachusetts physicians have borne a conspicuous part.

A review of the history of medicine in modern times calls to mind an exclamation of that famous Scotchman, John Hunter: "Of a' things upon the face of the airth a defineetion is the most carsed." He was addressing his students, it is said, at St. George's Hospital in the City of London more than a century ago. His sane, downright, Scotch spirit was in revolt against a supremacy of words in our science over all the facts of experience and observation.

Nevertheless it seems a proper and a cheerful thing to offer a definition at the beginning of an address.

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Let me, therefore, say, that by the science and art of medicine is meant the science and art of healing the sick. But this definition, as usually construed, deserves all the condemnation which John Hunter bestowed upon its kind; and I shall ask you to taste a "bitters" of the very wormwood and quassia of error and self-deception, but so sweetened and tinctured with pleasant condiments, I hope, as to send you to our annual dinner with sharpened appetites and stomachs in good humor.

We would fain believe that credulity and ignorance played upon by dishonesty and deception make up the sum of quackery. This is a mistake.

It is a familiar fact in the history of medicine that in all ages, as well in times of greatest enlightenment and civilization as in those of darkness and barbarism, have been found men accounted wise, with full faith in the healing virtues of charms and amulets, of the magic of a king's touch, of sympathetic powders or salves that were rubbed upon the weapon, of panaceas such as tar-water, of Perkin's tractors, etc. And in this our day when we look with pride upon the wonderful advances which our profession has made in the century now closing, we see all about us men of wisdom and influence,—trusted financiers, great inventors, philosophers, scientists, preachers,—who in their time of sickness do not hesitate to use proprietary or secret remedies of which they know nothing, to consult ignorant charlatans and quacks, or perhaps apply to Spiritualism or Christian Sci-

ence; and even instructed physicians, who declare a belief in the specific virtues of the attenuation of echoes of the explosion of alchemy,* or like miraculous products of a pharmacy of words.

So appalling seems the mystery of life and death, so strange and inexplicable the phenomena of health and disease, that it is no wonder that superstition has hovered over them and taken these things to its peculiar care. The subtle influence of the passions and emotions, the imagination and even of the will, over the nutrition of our bodies, has all the charm of magic and the supernatural.

Astrology, alchemy, medicine, appear closely associated through all the ages, working for the advantage of humanity.† The first, studying the heavens to cast the horoscope of man and reveal his destiny. The second, compounding the elements to bring forth the philosopher's stone to give riches and eternal youth to man. The third, seeking for medicines of the earth to heal his diseases. Medicine has claimed to hold a more exalted position than the others as having dominion over life and death. Alas! not even the revelations of the microscope, "that telescope of the inner firmament," as Dr. Holmes has called it, have been able thus far to justify the claim. Astrology slunk away like a ghost before the dawn

* A very intelligent homœopath told the writer that the three-hundredth dilution of "natron muriaticum" was a specific for malarial fever.

† "Astrology, alchemy, the once general belief in the healing effect of the royal touch, are only various exhibitions of one superstition, having for their essence the same little grain of truth, and for the outward expression different forms of error."—"A Book about Doctors," by T. Cordy Jeaffreson.

of astronomy. Alchemy was exploded and we have chemistry. But medicine has long wandered groping, enveloped in fogs and darkness of theories, or stumbling in the quagmires of systems.

All the so-called systems of medicines since the time of Hippocrates have been mere subtleties of the human mind, hypotheses, dogmas, words. These systems have taken a great variety of forms, which resolve themselves mainly under two classes, the material and the spiritual, matter and mind; and medical science may be typified as a huge snake going round and round through the cycle of the ages trying to seize its two tails of many hues, now one and now the other, or frequently both together, as in the spiritual theory and chemical practice of the pseudonym charlatan Bombastes Paracelsus, or in the attempt of Hoffman of Leyden to reconcile the material and the spiritual views, or of Cullen in Scotland with his "solidism" and "spirituality." Even up to the present time the unhappy snake seems to be trying to swallow himself, finds that he disagrees with himself, and only makes healthy growth in the accumulation of facts and observations. The perennial Goliath of theory has been slain over and over again by the one little stone of fact; the hydra heads of system have been stricken off, one after another, by the Hercules, Common Sense.

The art of medicine, or of healing the sick, seems to be indissolubly associated in the minds of men with the use of drugs or physic of some sort. The physician is the dispenser of physic.

There is an universal feeling that you must take something if you are sick. "You are ill, what are you taking?" is the inevitable question. Now, if we have not learned it by experience, we have been told often enough by our most learned teachers and practised professors, Bigelow, Holmes, Cotting, in this Society, as well as by others of great renown in England and Europe, that there is no such thing as a specific, and that diseases are not cured by drugs. This may not be absolutely true, but it points to a grave defect in our definition of medicine as the "art of healing the sick."

The very protoplasm of quackery, so to speak, exists in the faith in specifics, in systems based upon the effect of drugs. The fallacy of the evidence, *i.e.* the so-called "*facts of experience and observation*," is abundantly shown in the recommendations and certificates of quack medicines. It has been wittily said that to bring forward a hundred cases successful under the use of some remedy or system "should have no more effect than showing so many fat people in proof of a good government."

In that musty thesaurus of worm-eaten quotations, "The Anatomy of Melancholy," are many passages from forgotten authors showing contempt for doctors and their drugs; "but," says the author, "I will urge these cavilling and contumelious arguments no further, lest some physician should mistake me and deny me physic when I am sick; for my part I am well persuaded of

physic. I can distinguish the abuse from the use. I acknowledge it a most noble and divine science. 'The Lord hath created medicines of the earth and he that is wise will not abhor them,' saith Ecclesiasticus."

Now is not this attitude of mind of Robert Burton seen to be similar to that of many of the wisest of mankind, physicians or not?

But there is something still more to my purpose in this unique book. Burton enumerates some fifty or more drugs and simples in which he has faith, including a few which he deems indispensable to the armamentarium of the physician. To-day scarcely one of them is believed to have any special value, or is thought worthy of mention in our Pharmacopœias. If the medicines approved by this sagacious, philosophic and erudite author have not borne the test of time, what grounds have we to expect that other and newer remedies may have a more enduring success?

So that we are led to ask why do we ever employ anything but simples or expectant remedies, or methods intended to increase the vigor of the body or to restore a disturbed equilibrium? Why do we ever give supposed specifics? First, because our patients wish, nay demand, that such remedies shall be tried, and secondly in obedience to fashion. For, as you well know, there is a fashion in drugs and modes of practice, and for the doctor to ignore the latest fashionable treatment, or decline to use it, is to run the risk of being thought ignorant, narrow-minded, or wanting

in liberality, and thus to lose the respect of the community, and even, let me say it, of his confrères. It matters not at all that he has seen remedies and modes of treatment brought forward and advocated in our great societies with scarcely a word of dissent or disapprobation, declared to be almost specific, recommended by high authorities, supported by plausible theories, and yet, after a longer or shorter experience, abandoned as useless or uncertain, and now chiefly remembered as having been sometimes followed by dangerous or alarming symptoms, and even *fatal effects*. There are people in the world who would rather die under "the latest treatment" than get well unfashionably.

The recommendations of a new remedy amount to this: "I was ill, I took something, and now, thank God! I am well." But the success of the specific is always found to be in inverse ratio to the virulence of the epidemic.

If the connection of cause and effect were immediate and certain, the "post hoc propter hoc" as clear and evident, let us say, as a chemical reaction, the use of drugs could no longer be looked upon as empirical. But, as Dr. David Cheever says in his admirable Boylston Prize Dissertation on "The Value and Fallacy of Statistics,"—which I regard as a distinct dialectic contribution to Medical Science, — "The mere observation of simultaneous or consecutive occurrences, however great the number of cases, can lead to no definite results which may not be fallacious."

"Effects are ascribed to drugs which really flow from natural causes and are but the usual succession of the morbid phenomena; sequences are taken for consequences and all just conclusions confused."

The first great epoch in the history of medicine in modern times occurred, as I think, in the latter half of the seventeenth and the beginning of the eighteenth century. This may be said to have begun with the discovery of those important white corpuscles of the blood, and the perfecting of the lens of the microscope, by Leuwenhoek.

The other great names of this epoch are Sydenham, who gave us the present method, a rational empiricism; Boerhaave, at Leyden, who introduced the clinic and an eclectic practice; Haller and Morgagni, who taught the preëminent importance of the studies of physiology, pathology and anatomy; and others, such as Stahl and Hoffman who also had clinics at Leyden, "whom human memory need not charge itself with."

Then it was that medicine, both in the schools and the practice, appeared for the first time before the modern world with something of the dignity of true science. Still the reasoning continued to be a fruitless induction, an attempt to explain the inexplicable and think the unthinkable, as was the case with Cullen and Brown. No one surpassed the stature of Herman Boerhaave who, in his farewell address to his pupils, declared "that man to be the first physician who knew how to wait for,

and to second, the efforts of nature;" the true doctrine of the father of our art.

But at the close of the eighteenth century came the greatest epoch-making single event in the whole history of medicine; vaccination.

I give this the first place among epochs in the history of our science, because then for the first time the fact appeared, that the noblest, the most beneficent, mission of medicine to mankind is in the saving of human life.

No one who will carefully review the frightful history of small-pox and dispassionately weigh the evidence, can hesitate to admit that, during the century of its employment, vaccination has been the indirect means of saving millions of human lives.

Excepting Jenner's own suggestion that this discovery might prove the clue to a new explanation and perhaps a new treatment of many diseases, no deductions of any value were made from it, and it was looked upon as a piece of fortunate empiricism. Jenner planted and died, but two generations and more were needed to ripen the fruit upon his tree.

In the very first years of the present century a new day dawned for the study of medicine when Xavier Bichat, by experiments upon animals, placed on an impregnable basis some most important facts of physiology and pathology, and introduced the subjects of histology and cell-biology. His too early death left the world upon the threshold of what have since proved in the hands of

others, especially Virchow, to be most valuable discoveries. The monumental work of Rokitansky in morbid anatomy should not be overlooked.

But Charles Louis, — assisted doubtless by the practice of physical diagnosis and the employment of the stethoscope of Lænnec,—made an epoch in medicine by the introduction of a method of precision never attempted before. Genius has been defined as a capacity for taking pains. Louis abandoned a lucrative practice and consecrated seven years to exclusive clinical and anatomical, or pathological, study. He instituted as it were a tribunal, before which were brought all the various systems and modes of medical treatment then in vogue.

Nature herself was, so to speak, placed upon the stand and questioned, and her testimony was found to completely refute the often conflicting evidence, often ill-digested, partial or prejudiced, upon which was based the medical practice of the civilized world. The solidism and atony of Cullen, the sthenia and asthenia of Brown, as well as the gastro-enteric theory of Broussais, all had to give way before the precise inquiries of Louis, and his rigid application of the method of statistical enumeration conferred for the first time upon medicine the right to be truly called an inductive science.

Louis was what Carlyle delighted to speak of as "a most lucid, veracious man." He inspired his pupils with his own fervent, unselfish devotion to scientific accuracy and truth, and we were most

fortunate in our medical school, and in this Society, in having three splendid examples of his teaching in Shattuck, Bowditch and Holmes.

Louis insisted, and *demonstrated by post mortems*, that in many, if not in all, maladies, notably in the three great scourges of the civilized world, viz., Phthisis, Typhoid, and Yellow Fever, the course of nature was shown by analysis of the statistic to be uncontrolled by remedies.

But what then becomes of our definition that medicine is the art of healing the sick, which we must admit to contain the chief title which we have to the confidence of our patients? Must we stand hesitating and inactive by the bedside of mortal disease because we have been shown the uselessness of all specific treatment heretofore employed?

Louis himself answers this question when he says, "We can only hope for a moderate success even by the best adapted treatment," but this "does not warrant the rejection of an empirical treatment, however absurd or ridiculous it may appear, since it is against an unknown cause* that our therapeutical agents are employed."

That is the point, "an unknown cause." It hath been as the darkness around Ajax;

"Give me to see, and Ajax asks no more."

When I was a young man the inspiration of the spirit of Louis was fully alive and recognized in

* "It is obvious that we have present in all our formulæ of vital phenomena, in health or disease, an UNKNOWN ELEMENT, which no algebra or calculation can resolve."—Boylston Prize Essay for 1860, by David W. Cheever, M.D.

the profession here. Jacob Bigelow, Wendell Holmes, and Benjamin Cotting, reverting again to the teaching of the Father of Medicine, and pointing to the excellent motto of this Society, "Naturâ duce," wrote and spoke about the "self-limitation" of diseases, the value of the work of nature in disease, and especially the preëminent importance of the study of nature's processes when not interfered with by remedies. Something doubtless of the spirit of Louis was felt in the community. At least persons of intelligence and culture regarded the autopsy with favor, and the request for a post mortem was seldom denied except by those of foreign origin. This mode of thought was fostered and encouraged by the zeal of many of the younger men of the profession, who rarely allowed an opportunity to pass without *making an autopsy*, and using every argument to persuade those who were reluctant.

Henry Ingersoll Bowditch was a worthy pupil of a grand master. With the ardent enthusiasm of his nature he brought the spirit of Louis to the investigation of the phenomena of disease; he fired his pupils with his own zeal, as much as he drew them to himself by his benevolence, his devotion to the right and to truth, his generous impulses, his noble, unselfish nature. His absolute faith in the teaching of Louis remained, as I believe, to the last.

John Bernard Swett Jackson, an apostle though not a pupil of Louis, was one to whom many besides myself feel that we owe a debt larger than that

to any other man, teacher or friend. For absolute devotion of heart and soul and mind to the study of diseased anatomy, no man ever excelled him. As a macroscopic pathologist he had no equal in this country; as a teacher, his almost boyish eagerness in examining and explaining nature's aberrations, her morbid and abnormal phases, was an inspiration which the most cold-blooded could not resist. He delighted in showing the "characteristic morbid appearances," and in dilating upon the uncertainties of diagnosis. He insisted that symptoms were frequently present and presumed to indicate a disease which could not be found at the autopsy, while on the other hand disease might exist of which the pathognomonic symptoms had been absent during life. He never troubled himself or his pupils with theories, having as great contempt for them as Sydenham himself; while, as to the microscope in morbid anatomy, he held similar views to those of Cheselden,—William Cheselden, who says in his preface, "The study of anatomy as it leads to the knowledge of nature and the art of healing, needs not many tedious descriptions nor minute dissections; what is most worth knowing is soonest learned and least the subject of disputes; while dividing and describing the parts, more than the knowledge of their use requires, perplexes the learner and makes the science dry and difficult." You will see in Wendell Holmes's address to the students in 1867, that he, an enthusiastic microscopist and a learned anatomist, held much the same views as those of Cheselden.

Calvin Ellis was another earnest, patient follower of Louis. He also belonged to the class of lucid, veracious men. The conscientious thoroughness of his work was the admiration of all who knew him. If genius be indeed a capacity for taking pains, here was a man who possessed that kind of genius. His earnestness in the study of the physical signs and of symptoms, his enthusiasm in the clinic, his faith in the confirmation of the autopsy, his absolute veracity in the registration, these made him respected as a teacher, trusted as a guide. In dying his chief regret, often expressed, was that his immense collection of notes and observations, written in shorthand, could not be made useful to the world. It is to be hoped that the man may yet be found who will draw from this treasury the wealth which it contains for the benefit of science and for the honor of our profession.

"That colossal system of self-deception which has been the disgrace of medicine" must be swept away, and with untiring zeal and devotion these men and others like them, following in the path marked out by the great master Louis, strove to place medicine in the position of a true inductive science; a science which is "the topography of ignorance."

Thus was laid here in Boston, as it were, the foundation of a temple of medical science. But to further raise this structure there was needed a vast body of pains-taking, accurate observers, loyal to the truth at whatever cost, each of whom should place his stone upon the pile.

Thus, and then only, could the present method, the method of Sydenham and Boerhaave, a rational empiricism, be said to stand upon a philosophic basis.

But what is a rational empiricism? Perhaps I cannot better describe it than in the words of Dr. Amos Twitchell of Keene, N. H., who, in 1807, in a little country village, single handed, tied the common carotid artery and thus saved his patient's life; and of whom Dr. Bowditch wrote that "he was perhaps the most original mind our profession has produced in New England." Indeed, Dr. Twitchell was a man like Ian Maclaren's Weelum Mclure, one to satisfy the panegyrist and historian of Frederick the Great. When asked by one of his admiring pupils as to the cardinal principles of his practice, Dr. Twitchell is said to have replied, "If the patient is cold, I warm him; if he is hot, I cool him, if I can; this is the alpha and omega of my practice."

Such a method may have much to do with the art of healing the sick, but it has nothing whatever to say to the science of medicine. It is rational, but it is also empirical. It is the supreme philosophy of common sense.

As time has gone on much of the enthusiasm for the method of the famous physician of La Pitié has died out. Almost all that has remained of the idea of Louis, that it was possible out of systematized knowledge to make a science of medicine,* has been the numerical part, which has lost

* "In mathematics, we have the fact that geometrical theorems grew out of empirical methods."—HERBERT SPENCER.

all quality of verity since it has come to depend chiefly upon the observed effects of remedies. The notion still obtains that in some way cure is effected by the art of medical pharmacy; medical experience being one thing, and human belief another. It seems to be ignored that the numerical method of Louis as a test of the value of any mode of practice, is *sterile* without the autopsy.

For obvious reasons the post mortem has been neglected, at least among general practitioners, and it appears in consequence that the art of healing has sought to be divorced from the science of medicine; the "allegation of the libel" being "desertion and non-support." And what has been the result? Medicine and physicians have forfeited the prestige that once was theirs. Scant respect is paid to the title of "doctor," and the degree of M.D. confers no special distinction. The regular physician is allowed little influence in forming public opinion upon medical matters. There are many men in large practice who do not care to have autopsies, and never publish any valuable notes or observations. There are many medical graduates of our universities who do not seek to connect themselves with this, nor any other, society for the advance of their profession. The conscientious student of the *science* finds little honor or profit in the practice of the *art* of medicine. "The present system of medical expert testimony has degenerated into something which very much resembles a shameless and degrading farce." The councillors of this Society hold their

meetings in a mean, dark, half-subterranean apartment in a narrow court of the city. And as to the progress of medical science, we have had an etiology which could not explain itself, a therapeutic largely dictated by fashion, and a statistic containing returns of "causes of death" which are a confession of ignorance, such as "heart failure," "dropsy," "asthma," "convulsions," and many more, which as you well know are most frequently merely symptoms of some undetected organic disease. Perhaps this is only one of the evils brought upon us by homœopathy, which, according to its inventor and founder, declares that diseases have *no material cause*, but consist in symptoms alone.

After all, what does it matter, since, as it seems, the decree of absolute divore has been granted between the art and the science? It is not for us to cry "quackery!" upon any system, however absurd. The "tu quoque" confutes us.

More or less, in all ages and states of society, medicine has been the sport of fashion and the prey of delusion. In these days when all the world seems, as it were, to be singing the "ça-ira" in a French Revolution of thought and feeling, medical art has suffered in the general "débâcle". The spirit of the age being the enjoyment of life and the accumulation of riches, the autopsy, which has only value for science, has become discredited, if not abhorred, by the community. It is a well recognized fact that the hope of passing laws devised simply and solely for the advantage of

medical science, or for protecting the community against the spread of epidemic disease, is a chimera, the opposition cry being "Interference with the liberty of choice," as though it were possible that there could be any choice in such matters.* The search for specifics and panaceas has come to resemble that which went on, in the days of alchemy, for the philosopher's stone. It would seem at times as though men had been hypnotized by riveting the attention upon some shining fallacy of theory or practice. The adoption of specialties, while it has much to recommend it, inclines us to forget that the whole is always more important than any of its parts, and to put the infinitely little above the infinitely great. It is customary among physicians to prescribe in compliance with the prejudices of the time, rather than in accordance with the rational experience or observation of men.

Perhaps I cannot give a better illustration of my meaning here than by referring to the history of venesection. Nature herself in certain disorders indicates the advantage of the letting of blood. The practice has great antiquity to recommend it, having been employed by the "most learned and approved good masters" since, and very likely before, the time of Hippocrates; by Sydenham, Boerhaave, Louis, indeed by all the men who have marked the great advances in the art and science of medicine. At times discredited, again applauded, it has held its own and has outlived all systems and all theories.

* In Massachusetts the law does not protect the physician who hesitates to reveal the secrets of the sick chamber when called to give evidence upon the witness-stand.

In the early part of the present century the gastro-enteric theory of Broussais, who was followed by Rush in this country, led to the practice of indiscriminate and free use of the lancet; but Bouillaud in France with his bleeding "coup sur coup" in pneumonia, introduced a still worse method, so that Dr. Tully wrote, "the lancet is a weapon which annually slays more than the sword."

Those who were students in the Paris hospitals in the early fifties will remember the pewter porringer on a shelf at the head of every bed to receive the blood of the patient; and if you will examine that admirable work, "Le Guide du Medecin Practitien" of Valleix, Baillière, Paris, 1853, you will find under the head of treatment, "La Saignée" given the first place in nearly every disease in the five volumes. These were bad fashions.

But for more than forty years the practice of venesection has entirely gone out of use in our largest hospitals and among our most distinguished physicians. So much is this the case that the suggestion to "bleed" is met by doctors and patients with incredulous surprise, as though it were question of a capital operation in surgery. Every radical departure in treatment has been supported by some theory. The "change of type" theory, which grew, I believe, out of the Brunonian system, was brought forward to uphold the neglect of venesection. This theory was another of those vague speculations, chiefly dialectic, whose cloudy futilities have from time immemorial obscured the

pathway of medical science. It went into the dust-heap long ago, but the practice of bleeding, theory or no theory, has been discredited.

In that most excellent work, "The Principles and Practice of Medicine," by William Osler, New York, 1894, we read, "Pneumonia is one of the diseases in which a timely venesection may save life." And speaking of "Emphysema," he says, "On more than one occasion I have saved the lives of persons in this condition by venesection." And under "Chronic Valvular Disease," "This is the occasion in which a timely venesection may save the patient's life." Also, at page 1019, Osler states that the life of Dr. Weir Mitchell, when a young man, was saved by free bleeding in sun-stroke. I can recall in no modern work on "Theory and Practice" or "Therapeutics," a similar statement in regard to the effect of any drug.

I would say to you in the emphatic language of Rufus Choate, "Gentlemen, there is not one jot, not one tittle, not a scintilla of evidence which can impeach the testimony of this witness." In the cases cited by Osler the course of nature tends inevitably and swiftly to death. The effect of the remedy appears as indisputable as that of chemical reaction. For what purpose are we physicians if not to save human life, if it be in our power to do so! Are we to stand by and see our patients dying—as it were drowning, and we refuse to throw the rope which we hold in our hands—in obedience to the dictation of a heartless, senseless fashion!

It is humiliating! It is exasperating, to see how, in these times in which we live, fashion has become almost omnipotent in the realm of science and of ideas, and that it assumes to itself the same control over philosophic thought which it may properly claim to hold over the cut of our clothing, the decoration of our houses, or the manners of good society. In face of the impertinent interference of this tyrant in matters with which it has no concern, we seem to find but one comfort: We are living in an age of delusion which must pass away and give place to wiser counsels. I believe it to be a delusion which has crept into our universities in some measure, and also into the community at large, that the college is not a place exclusively designed to form the habit of scholarship, that young men enter it not alone nor principally to strive for high ideals, not to find the riches of literature, nor to encourage a love of knowledge for itself, — in short not more to train the intellect, than to train the muscles, to become proficient in various sports, or to excel in contests of strength or skill in gymnastics. I believe it to be a delusion to maintain that experimental biology (upon the lower animals) is cruel, and has never given to mankind any valuable knowledge; or that the phenomena of disease and health are controlled by psychical, or mental, influences entirely. I believe these things to be delusions, as it is a delusion to suppose that the unlimited coinage of a debased currency will bring about the prosperity of a nation.

The truth of the matter is this: The age of machinery and of cheap production have made it easy for all to supply the wants of food, clothing and shelter. We are paying the penalty of those who live in times of general prosperity and ease. The discovery of ether has robbed surgery of nearly all its horrors; while Christian charity and benevolence have increased the number and capacity of our free hospitals and provided for the poor, until no one needs to fear poverty, or suffering. The creature forgets his creator. Industry, thrift and economy, have almost disappeared in the land. Irreligion, luxury and extravagance, prevail in all classes of society. We are oppressed by the tyranny of "the common-schooled millions who have been taught to read but not to discriminate." There is a contempt for authority, almost no respect being paid to age, tradition or office. The faculty of independent judgment is weakened, "the acquiescent temper being cheaper than thinking," and popular success is made the criterion of merit. The virile power of the imagination is lost, when we hear men sneer at chivalry and patriotism.

There may be something of the Anglo-Saxon love of fair play,—the desire to side with the under dog,—in all this. Nature's plan of evolution by the survival of the fittest is unjust and cruel to the weak. We must feel for whatever is low or depraved in humanity. Criminals should be looked upon and treated as the moral scrofulæ, the unfortunate, deformed children of men, and our sympathy should be given to them, and not wasted on their

uninteresting victims. The wise must not control the foolish any more than the rich the poor. In politics mediocrity comes to the top, bringing with it the dregs of communism. In art vulgarity is glorified, and is given the halo of veracity in contempt of all that is sincere and noble. Men and women live a hot-house life, and propagate and encourage the abnormal growths, the moral and intellectual "sports" of our nature.*

Indeed, we may say that society seems to be dancing "La Carmagnole," while common sense and good taste are "sneezing into the basket." Why should we have a cult of such dubious things as "the music of the future," the repulsive freaks of Japanese sculpture, dialectic poetry coarse and profane, or the drama and novels of "realism" which paint

> "Coarse lusts of habitude,
> Prurient yet passionless, cold studied lewdness
> Depraving nature's frailty to an art!"

Fashion demands that we have new altars and new science. The worship of God as ordinarily understood being unfashionable, the very instinct of reverence apparently gone out of us, we have Theosophy or Rationalism; and in medicine we have "Christian Science," presented to us in a dish of the very froth of Bishop Berkeley's metaphysics, stirred into "clotted nonsense," and garnished with mottoes of Scripture and flowers of

*"The marriage vows are looked upon as grotesque, and it is considered ridiculous that little children should stretch out their arms to embrace a father and a mother."—"The Great Physician," by François Coppée.

poetry. This has its churches and its gospel. It is a religion which with much justice claims to itself the soul of homœopathy; it is a science of medicine which, as some one has said, "deals with people's insides from the point of view of men who have no stomachs."*

Are there any who will say this picture is overdrawn, or that nearly the same state of things has existed before? Pardon me! This is not merely a case of the follies of an age confounding its wisdom. The vagaries of human thought have little to do with it. We may discard all that pertains to the supernatural as well as all the ferments of popular discontent, but the discoveries of modern science are simply incredible. The advance of surgery under asepsis excites the wonder of the world. Nothing now seems impossible. "The thing that could n't has occurred." We feel as if invention had ceased to respect the mechanical paradox. The Ferris wheel and the ubiquitous bicycle are examples of this. Look at the seeming miracles of electricity! It has "put a girdle round about the earth in forty minutes;" it has, as it were, annihilated time and space. Listen at the telephone and phonograph! Examine the kinetoscope and skiagraph! See the bright light that burns without oxygen! See yonder loaded car drawn along our streets by no other apparent agency than a little wheel rolling upon a wire! The fin-de-siècle is to soar with the birds and to

* "It is instructive to reflect that the Paris which made Mesmer its idol was not far distant from the Paris of the reign of terror."—"A Book about Doctors."

harness the lightning of the clouds! Are we not indeed encompassed by illusion more than ever before in the world's history?

Doubtless there have been physicians who have felt disheartened at the humiliation of our noble profession in this age of delusion. They may well have cried to God:

"We look to thee; thy truth is still the light
Which guides the nations groping on their way,
Stumbling and falling in disastrous night,
Yet hoping ever for the perfect day."

There is yet another definition of our science, viz., that it is the theory of diseases and of their treatment. But among all the theories how to know the true one is the question. The only solid basis for a theory must be found in the facts of physiology and pathology. But beyond the pale of pathology there exists a *something* which cannot be accounted for, and must be reckoned with. No! what medicine has sorely needed has not been dialectics nor definitions, not theories nor systems, not even a greater mass of accumulated observations, classified, analyzed, made the basis of a true inductive science. Two things have been eternally wanting; first, the discovery of an efficient cause; second, the saving of human life and the cure of diseases through that discovery.

The evolution of the soul of a science is a slow process. Ages of time and many minds are necessary. The science of medicine has been a body without a soul.

When Newton saw the apple fall, and recognized and developed by an admirable deduction the great principle of gravitation, he gave to astronomy the soul that was wanting to a body of incongruous knowledge largely tainted with astrological superstition.

> "Nature, and nature's law, lay hid in night;
> God said, 'Let Newton be,' and all was light."

When Lavoisier weighed the oxygen of the air he made the balance the ruling instrument of his science, and proved that all chemical action is only substitution. Thus was alchemy exploded and a soul given to chemistry, which then for the first time threw off the thraldom of magic, and took its appointed place as a noble and divine science.

In like manner when Louis Pasteur, perceiving that the essential element of fermentation was a living organism, disproved the doctrine of autogenesis, and by a bold deduction declared that all infectious diseases were caused by germs, he did for medicine what Newton did for astronomy and Lavoisier for chemistry. He emancipated it from empiricism, and gave to a body of unexplained and inexplicable phenomena which constituted the art of healing, the soul that was wanting to make a science of medicine. He had discovered an efficient cause.

The plan of my discourse leaves me no room to speak the eulogy of Louis Pasteur. The subject is a grand one. I confine myself to my topic, which is "An epoch in medicine in an age of delusion."

Let us briefly review the history:

Since the earliest dawn of civilization, and among savage and barbarous peoples, there has always existed the belief in some malign influence, some evil spirit or devil, which entered into the body, or dwelt in the body, and was the cause of sickness. All the theories and systems of medicine have recognized the existence of this "infection," sometimes supposed to be material, sometimes wholly or partly spiritual. The Egyptians, Greeks, or Romans, did nothing to advance our knowledge on this subject. The idea of minute animal or vegetable organisms as the cause of disease is not new;* but, since the revival of learning in Europe, the nearest approach to the true explanation was found in the doctrine of ferments. Until 1839, fermentation, however, was believed to be a *chemical* process.

The first halting step in this grand discovery was made when, in the early part of the last century, Lady Mary Wortley Montague brought the practice of inoculation from the East, and Richard Mead inoculated the royal princesses of England with the small-pox; and, as far as this country is concerned, when Zabdiel Boylston and Cotton Mather introduced the practice in this State of Massachusetts. From two points of view this is now seen to be important. It was the first attempt, ignorantly and empirically made it is true, to create an immunity to disease by the artificial

*Vide "Medical Notes and Reflexions," by Sir Henry Holland, chap. xxxi., 3d London Edition.

introduction of disease germs, or their products, into the human body. And secondly, when Jenner, in 1796, brought forward vaccination, the practice of inoculation with the small-pox virus was in vogue in England and readily accepted. Thus Jenner, veracious man that he was, was enabled to apply the experimentum crucis of small-pox inoculation to all those (or to many of those) upon whom he had tried his new process; and others followed his example. Doubtless "but for this fact, and this means of testing its efficacy, the practice of vaccination to prevent small-pox would not have found such ready and thorough acceptance by the world." This should never be forgotten. It is apt to be ignored by physicians, as well as others, who, trusting to the inadequate knowledge and experience of the present age in regard to small-pox, do not hesitate to question the value to the world of the practice of vaccination. The crucial test can no longer be applied, at least in civilized countries, but it is impossible to impeach the testimony of Edward Jenner in England, or of Benjamin Waterhouse in Massachusetts.

The next step, the discovery of Jenner, seems to have been only a happy inspiration which had a base no more solid than an observation of milk-maids.* Here again we find a value not at first perceived. The facts disclosed by the practice of

*There is evidence to show that vaccination, or something like it, was practised before the time of Jenner, but the modern civilized world owes its introduction as a reliable method of preventing the spread of small-pox to Jenner alone.

vaccination doubtless suggested the question of the true nature of susceptibility and immunity. The examination of this question led to another bold deduction by Pasteur, and brought about the discovery of the antitoxins.

In 1836, Dr. Oliver Wendell Holmes in a memoir on "The contagiousness of puerperal fever," pointed out that infection could be carried on the hands or on the person of the physician from one patient to another.*

In 1839, Schwan first clearly demonstrated the essential relation of the yeast plant to the process of fermentation, and Schönlein in the same year discovered the parasitic origin of favus.

Still these discoveries produced no valuable results to science, and it remained for Pasteur, in 1860, to conceive the idea that the acute infectious diseases were caused by the growth of microscopic parasites; a bold deduction which experimental biology has since proved to be correct. There now remained only the important question of the practical application of this discovery in saving human life and in curing human diseases.

The next step, and by no means the least important one, was the introduction of antiseptic surgery in England by Lister.

Looking back as far as we may in the history of surgery we find that there was a *something* which nobody could explain, that caused surgical fever, and made the fatality of wounds and of surgical operations. That wise old surgeon, Ambroise

* This was disputed by some of the highest authorities in this country.

Paré, declared that it was "miasms in the air which made wounds infect." Percival Pott, who had Wm. Cheselden for a pupil, is said to have employed a pretty fair antiseptic dressing; and others have used a variety of methods to prevent the access of air to wounds. But John Hunter declared that "we do not know, and probably never shall know, the cause of the fatality after wounds and operations." Simpson of Edinburgh, in 1846, wrote, "It is only by employing the numerical or statistical method of examination that a perfect degree of accuracy of judgment can be possibly attained in such matters." So eminent a surgeon as the late Dr. Henry J. Bigelow told me, in 1866, that he had failed in every case of ovariotomy he had tried, and should never attempt those operations again; "but you, as others have done, will succeed," said he. The wonderful insight of that remarkable man was perhaps never better displayed than in this remark. It meant that there was "a something" which we did not know which made these operations fatal, and that "something" was to be found in the person of the operator.

Lister was not the first to suggest the notion of miasms in the air; nor of something in the hands or person of the surgeon, or in the instruments, or dressings which were used; Lister did not invent the antiseptics which he employed; least of all did he discover the fact that surgical fever, sepsis, or necrotic processes in the tissues, are caused by microbes. Yet, "as the orignator of a

system of wound treatment, his name will go down to posterity as having rendered incalculable service to humanity." His method has been essentially modified in nearly every particular, but "the great principle upon which it is founded will endure so long as a system of surgery exists."

It is to the investigations of Pasteur, Koch, and other bacteriologists, that we owe all that was new in Lister's method. These men proved by cultures, by vivisections and inoculations practised upon the lower animals, that sepsis, or surgical fever, the bugbear of John Hunter and of all surgeons up to that time, is caused by the growth of a microbe, a streptococcus, or staphylococcus, found upon the skin and mucous membranes of surgeon and patient, and also in air and water, which infects the wound during operation, or finds its way into the wound through the dressings; that these microbes exhale an odor resembling sour paste, that they do not require the presence of oxygen for their growth, that they are killed by a temperature above 150° of Fahrenheit, and also by contact with various substances now known as "antiseptics."

On the occasion of the "50th anniversary of the First Public Demonstration of Surgical Anæsthesia," Dr. McBurney said, "Bacteriology has penetrated with its brilliant light a darkness which our predecessors believed would last forever." And again he speaks of the wonderful discovery of aseptic treatment of wounds, "through whose agency countless thousands of human lives have been preserved."

And on the same occasion, Dr. Cheever said, "Hand in hand, equal benefactors, anæsthesia and asepsis march calm and triumphant."

Yes! the saving of thousands upon thousands of lives, and "The future of surgery without limit," these are the gifts of asepsis to our science. We can say as Warren said of ether, "This is no humbug."

There now remained only the question of applying these discoveries to the cure of diseases.

Following out the suggestion of Jenner's discovery, many attempts have been made, chiefly upon cattle and sheep, to create an immunity to disease by inoculations, "but it is especially to the experimental researches of Pasteur that we are indebted for the development of practical methods." Pasteur made the discovery that susceptible animals, inoculated, or, as he said, *vaccinated*, with attenuated cultures of microbes, become immune to those microbes; that by a graduated series of inoculations a susceptible animal becomes fitted to receive without injury a pure culture of a virulent microbe, the effect being cumulative. The practical application of all this was made later in anthrax and hydrophobia, and it was shown that an animal can be made immune to the infection of these diseases, even when the poison has been carried into the body before beginning the protective inoculations; many experimenters working upon these discoveries. The next step was to find that this power resided in the blood-serum of animals which had been made artificially immune, and

that this serum, filtered, sterilized, and thus rendered perfectly harmless, was not only protective, like vaccine, but in some cases also curative. Out of these facts came the invention of serum-therapy, with which you are all more or less familiar. These facts, of the highest importance to mankind, were demonstrated by vivisection and other experiments upon the brute creation, and they could be proved in no other way.

Thus it was that the discovery of the efficient cause was brought to the point of curing human diseases.

In spite of the convincing character of the evidence afforded by the facts of antiseptic surgery, there will be those who, persisting in the delusions of medical pharmacy, will question the value of Pasteur's discoveries, as was the case with inoculation in 1720, with vaccination in 1796, and *with ether in* 1846. The antitoxin treatment is only in its infancy, but of its ultimate victory over the minds of men there is no room to doubt. It is certainly unphilosophical, unreasonable, irrational, to contend that facts of this nature, which have been proved upon the lower animals, do not apply to man.

The invasion of the microbe into the body of pathology has raised many interesting questions. That of the true nature of racial, or family, or individual, susceptibility and immunity to certain diseases, remains, and probably ever will remain, unsolved.* We may expect to find that the anti-

*The personal equation can never be entirely eliminated from the problems of the physician.

toxins will not succeed in every case, for this is true of vaccination, and is suggested in the history of epidemics; but the cases of insuccess will be individual and exceptional. That the remedy will be found to apply to the great bulk of mankind may be safely asserted.

To repeat Dr. Warren's words again, "Gentlemen, this is no humbug."

Sternberg enumerates several hundred microbes which have been already obtained by bacteriologists and grown in cultures. Not all of these are found in man; but among them are the germs of nearly all the most frequent and fatal maladies to which human beings are subject. Tuberculosis [consumption], cholera, the plague, typhus, typhoid and yellow fever, erysipelas, diphtheria, croupous pneumonia, meningitis, endocarditis, influenza, infantile diarrhœa, besides the rare, but fatal diseases, anthrax, tetanus and hydrophobia, are among those found to be due to germs. The treatment by antitoxins has not been successfully applied in most of these, and the fact must be emphasized that much, we may almost say *everything*, is yet to be learned concerning the practical application of Pasteur's and Koch's discoveries.*

It is unbecoming in one who like myself is not a bacteriologist, nor even a microscopist, to enter upon the discussion of this intricate subject. The trend of biological opinion seems to be towards a

*One needs only to study the chapters on "Pathogenic Bacteria" in Sternberg's superb "Text Book of Bacteriology," to become aware of the fact that, indeed, we have no more than entered upon the investigation of this intricate subject, and must perhaps await the coming of another Pasteur to bring to fruition the wonderful discovery of the anti-toxin treatment.

vital, rather than a chemical or structural, explanation of immunity to disease. The vital properties of the proteids, of nuclein, globulin, etc., are beyond our chemistry, their molecular structure beyond the powers of the microscope, and it may be that too exclusive reliance has been placed upon the sense of sight in questions of germ pathogeny.* We can set no bounds to the enlargement of our mental horizon by the revelations of physical science. Human ingenuity will doubtless find ways to enlarge the powers of our other senses. That which has been called "the sixth sense," and which has been nearly civilized out of existence in man, may, in ways not yet revealed, be made to assist in the examination of phenomena which are, like instinct itself, vital and functional rather than chemical or structural, and "other beneficent discoveries in the future may lead up to unimagined possibilities."†

* The polymorphism of microbes finds analogy among the fungi, in which the "pro-embryo" of Hofmeister often appears under many forms, "always unlike the parent," and the various orders of cryptogamia are seen to present remarkable differences in this respect.—"Gray's Botanical Text Book," 4th Ed. p. 341.

† There are many interesting and suggestive analogies, or seeming analogies, between horticulture and medicine. The bacteriologist Toussaint,—who was probably the first to show the practicability of conferring immunity upon animals by protective inoculations,—discovered the fact that the bacillus of anthrax does not form *spores* in the body of an infected animal, but multiplies only by binary division of the mycelium. Thus when this microbe grows in a susceptible animal,—as it were in a favorable soil where it flourishes most abundantly,—it spreads by fission (increasing as fungi frequently do by multiplication of their vegetative cells, or as plants often do by offshoots or divisions of their roots and branches), and not by producing spores, which are the culmination of its vegetation, just as flowers (or embryos of the flowers) are the final product of the life of flowering plants. Now it is a fact familiar to the florist that many plants if grown in rich soil and thriving vigorously, run to wood or leaf or root, but do not flower. Again it is interesting to note that certain fungi which cause vegetable blight have a heteroecious development (for example, pear-leaf blight, the spores of which are the product of an apparently different fungus found upon the juniper), and that we have here an analogy to the supposed origin of vaccinia in "the grease" of the horse,—in which Jenner believed. These analogies may perhaps throw light on the origin of epidemic diseases, and explain the periods of interval or disappearance.

There are perhaps enthusiasts who will exclaim that all this will revolutionize medical practice. I do not share in this feeling. It has been discovered that the specific action of quinine in malaria is due to the power of this drug to destroy the corpuscles of Laveran in the blood of the patient. It needs no seer to tell us that, as there are many surgical antiseptics, so there must be many remedies whose acknowledged therapeutic value will be found to lie in their power to destroy or expel pathogenic microbes, or to so immunize our bodies as to render these parasites inert and harmless in the fluids and tissues.

Dr. Roswell Park of Buffalo has indicated certain conditions of the system which tend to impair or destroy immunity or the power to resist microbic infection, and, therefore, may increase the liability to disease from this cause. These are toxæmia and anæmia, the presence of foreign bodies, paralysis of nerve influence, obstruction to circulation, to secretion or to excretion, hemorrhages, freezing, degeneration, etc.

It is also thought that resistance is diminished in parts where retrograde metamorphosis is going on, and that this explains the frequency of appendicitis, and of germ infection in the lymphoid tissues about the pharynx. Whatever tends to impair the natural vitality (such as neglect of hygiene and sanitation, crowding, privations and excesses, various poisons, exhaustion, the depressing passions, etc., and certain climatic, telluric or electric influences), encourages the growth of

those microbes which are found within the human body, and which under favorable conditions may take on the character of virulence. The clinical symptoms of disease, then, are the signs of the struggle of nature to rid itself by the ordinary physiological processes of a parasitic pest, either by destroying it or neutralizing it. Thus we find ourselves again on the old Hippocratic ground. The first physician will be he "who knows how to wait for and to second the efforts of nature," as Herman Boerhaave declared nearly two centuries ago.

The prolonging of life is a boon only on the condition of relief from suffering; the field of symptomatic treatment is always open to the physician, and the grateful work is his of smoothing the pathway which all must tread to ineluctable death.

The department of the public health affords a natural field for the bacteriologist. But I do not propose to dwell upon this branch of the subject.

The value of serum inoculation as an aid to diagnosis has been shown by the employment of tuberculin in cattle. It seems to be now admitted on all hands that the rise of temperature which follows its use in diseased cows, is an established fact, and is a certain indication of the presence of tubercle in these animals. Other ways suggest themselves in which the antitoxin serum can be made useful in diagnosis and prognosis in man, and some have already been tried.

The work of Dr. Ferrán in Spain and of Haff-

kine in India, with anti-cholera vaccine, marks the first great step since Jenner's time in the direction of stamping out other epidemic diseases, as has been done with the small pox.

Experiments at the Children's Hospital in this city by Dr. F. Gordon Morrill in the use of diphtheria antitoxin as a prophylactic, or an immunizing agent, have had encouraging success. But perhaps little can be accomplished in this way except in times of virulent epidemics. The inoculations seem to give a temporary increase of the power of resistance, but do not confer a vital immunity; and this is in accordance with the observation of other experimenters.

There may be diseases which are not due to microbes. Whether these are many or few, they cannot be included among those most dreaded and fatal. A development of virulent bacteria is almost invariably accompanied by a rise of temperature and other clinical signs of fever and inflammation; whenever there is contagion or infection, we must infer the existence of a germ.

But there is a class of disorders to which Sydenham applied the name of "hysterical diseases." They furnish perhaps the major part of the daily practice of physicians. As the name implies they belong principally to women, but as man is born of woman he inherits her diseases.

It may be doubted if these disorders depend upon the growth of parasites. They are peculiar to man, and have not been produced or studied in the lower animals. Hard-handed and primitive-

living peoples are little liable to them. They are apparently weeds, or by-products, of the garden of civilization and refinement, anomalies, "sports" forced under steam culture, as it were; or they may be *the inheritance of the unnatural selection of the unfittest*, and such patients are prone to become victims of every form of medical delusion.

Generations may pass before the fruit will be fully ripe upon the tree which Pasteur has planted, but I believe the time will come when no instructed physician will talk of "healing the sick" by any other methods than those which shall grow out of these discoveries; and that he who continues to believe in so-called specifics, or who holds that the art of medical pharmacy is superior to all knowledge of the causes of disease, to the revelations of bacteriology, or the facts of germ-pathogeny — and ignores these things, must stand "marking time" in the ignoble army of charlatans and quacks.

Experimental biology and the bacteriological laboratory have become an integral part of our medical schools; for here is no theory and no delusion. The analogy between the phenomena of disease in the lower amimals and those in man, will be found to be complete. The student is working not with *words*, but with the *facts* of experiment and observation.

Let me recall to your minds the part which Massachusetts physicians have taken in these discoveries. Zabdiel Boylston of Brookline inoculated his only son, and suffered social ostracism, in the cause of small-pox immunity. Benjamin

Waterhouse of Cambridge introduced vaccination into this country, and proved its efficacy by small-pox inoculation in this vicinity. Oliver Wendell Holmes first pointed out the fact of personal infection. Here anæsthesia was first practised, without which antiseptic surgery would be well nigh impossible. Reference has already been made to various dialectic contributions by Fellows of this Society, pointing to these discoveries. These things are part of our history. To-day we find a hearty acclaim accorded by the profession here to the serum treatment, so that we may say with pride that, even in this age of delusion, this Society of Massachusetts physicians stands at the fore-front of scientific progress.

Gentlemen, we can but imagine the feelings of such men as Herman Boerhaave, Edward Jenner, Charles Louis, James Jackson, and others long dead, could they have seen their science brought through the slough of despond, and led to the gates of truth and light.

Without reservation we may now exclaim in the words of Bowditch, "The profession of medicine is man's noblest work, and the physician is God's vice-regent upon earth."

NOTE.—The course of the argument in this paper has called for a rehearsal,—which must needs appear "stale, flat, and unprofitable,"—of trite facts in the history of medicine, which otherwise should not be presented before The Massachusetts Medical Society without apology.

ARTICLE XXI.

THE SHATTUCK LECTURE.

THE NEW SURGERY.

By DAVID W. CHEEVER, M.D.
OF BOSTON.

DELIVERED JUNE 8, 1897.

THE NEW SURGERY.

WHAT can it do now that it could not do before? What can it do better now than it could before?

Anæsthesia, as well as asepsis, must answer these questions. The one gave us painless operations; the other painless healing. One annulled consciousness, the other prevented inflammation; one rendered possible delicacy of manipulation, the other averted suppuration and absorption. Formerly suppuration was frequent, and primary healing rare; now primary healing is the rule, and suppuration the exception. Healing is measured by days, instead of by weeks; surgical fever is nearly always absent. The hectic of suppuration is happily wanting; the chill of sepsis unusual; secondary hemorrhage unknown, unless the result of trauma. Ligatures are buried and encysted or absorbed; sutures are cut and drawn out dry as when put in; pain is little; constitutional disturbance often slight. Scars are less deforming; adhesions less contractile; keloid less frequent; recurrence, locally, more favorably affected. Three dressings take the place of twenty; there are no ligatures to pull away; and none to fear to touch, because they may prematurely loosen the stream of some great vessel.

We will try to describe these great changes without exaggeration, and proceed to speak of them in detail.

Let us look back seventy years, to 1827, when the work of Benjamin Travers, F.R.S., senior surgeon of Saint Thomas's Hospital, on "Constitutional Irritation," appeared. Chapter II., "On examples of direct constitutional irritation induced by inflammation following punctured wounds and abrasions of the fingers in dissection"; and Chapter IV., "On examples of direct constitutional irritation induced by the admission of a poison into the system by a wound, or abraded surface." In Chapter IV. are given sixteen cases, of which twelve died.

Venesection, cupping, leeches, calomel, antimony, senna, opium, ammonia, stimulants, few and spare incisions, poultices, lead lotions, were the remedies used. It is, however, justice to Mr. Travers to say, that bleeding was soon found to be useless, and a supporting treatment was advocated in the later cases. What strikes one, however, was the absence of anything antiseptic, or cleansing; the too slight use of free incisions, and the malignancy of the symptoms, which ranged from lymphangitis to diffused suppuration of the cellular tissue; to erysipelas of the phlegmonous variety; to gangrene, to sepsis and general pyæmia. In varying degree these conditions showed themselves in all the cases; and death followed, in from one to eleven days, in seventy-five per cent. of those wounded. This sad mortality occurred in one surgeon's practice; mostly from October to January of one autumn term of the medical schools. There were affected: a professor of anatomy; an army surgeon; a naval surgeon; a civil surgeon; four physicians; eight medical students; not to mention an undertaker and a servant. Of the sixteen professional men and students, twelve died.

Thirteen cases followed wounds received in autopsies on persons very recently dead; and three from dissecting-room subjects. In one case, Mr. Newby's, it is instructive to note the contagious, or infectious character of the disease.

Mr. Newby opened the body of a child dead of enteritis (*Query.* peritonitis?), and had a pustule appear on a wounded thumb. He had deep-seated pain in the left breast; and a pink tinge there; a tumor from the sternum to the scapula, and from the clavicle to the hypochondrium; fetid stools; a brown tongue; a swollen arm; effusion of brown serum. He died on the eleventh day.

Now mark the consequences. Mr. Jackson, his assistant, had an erysipelatous throat and abscess of the tonsil; his pupil, a low fever; the housemaid, tonsillitis; the nurse, fever and a stiff neck (cellulitis), followed by phlegmonous erysipelas, which was fatal; the woman who laid out Mr. Newby's body had phlegmonous erysipelas, but recovered. Five cases resulting from this one of Mr. Newby's; apparently none who were in contact escaped, except the attending surgeon.

What would be the moral effect today, if such an epidemic of preventable poison occurred in our community and carried off twelve persons engaged in the pursuit of pathology and anatomy? Contrast it, if you can, and mark the difference in hygiene, in sanitation, in treatment, in the chances of professional life.

All this occurred in this century, in the great medical centre of London, under the best surgeons, Sir Astley Cooper being one of the consultants.

Mr. Clifton of Islington, aged 37, scratched his thumb with a needle while sewing up the body of a female who had died of peritonitis. He was under the care of Dr. Gordon, of Finsbury Square. At three o'clock the next morning he was awakened with excruciating pain in the thumb and forearm; after ten hours the surgeon describes the arm as tense and swollen; very severe constitutional symptoms and pain; nausea, headache, anxiety, oppression in the chest; pulse full, hard, and one hundred and twenty. A large dose of calomel, and bled to thirty ounces; a poul-

tice, a febrifuge and aperient. This was followed by a sleepless night and terrible pain; hand and arm much swollen; red line of absorbents; pain in axilla; appeared much sunken, and complained of head greatly. Leeches and cold to temples. Next day, dreadful pain and lack of sleep; hand and arm more swelled; pulse full and hard, and one hundred. Bled twelve ounces; leeches applied; pulse one hundred and thirty; overwhelming oppression in chest and head; bled sixteen ounces; leeches and purgatives. Next night, in agony, no sleep; pulse one hundred and twenty; hard and wiry. An incision made in hand and thumb—a little pus; immediate relief; poultice; fell asleep. During this sleep he bled very largely in the poultice, and fainted. Later, pain returned; pulse rose to one hundred and twenty, full and hard. In three days more, one hundred forty leeches were applied. Then followed collapse, sighing, pulse one hundred and forty, soft and compressible. Opium was now used freely; he improved; the application of leeches was only necessary twice more, and purging. He recovered.

The streptococci and staphylococci must have found exit with the fifty-eight ounces of blood taken from the veins, and the one hundred and forty leeches; and have been also eliminated by the purging. What is noticeable, from our point of view, is that all these heroic measures were taken to allay inflammation—whereas inflammation was a symptom only of the putrescent germs running riot in the blood.

From this time on, mostly in war, but also in peace, hospital gangrene prevailed occasionally, down to twenty years ago. In civil general hospitals wards had to be closed on this account; while pyæmia and hospitalism were often fatal to the wounded, as well as to the puerperal woman.

The fate of a compound fracture is a good barometer, or measure, of the healthfulness of a hospital, and of the

sanitary success of treatment. From 1864 to 1869, about thirty years ago, we learn from the first quinquennial report of the Boston City Hospital, there were treated one hundred and twenty (120) compound fractures. Of these over one-half (66 per cent.) came to amputation. Of the compound fractures of the upper extremity forty-one (41) per cent. died; of the lower extremity sixty (60) per cent. were fatal. Of those amputated, the thigh had a mortality of fifty-six (56) per cent.; the arm thirty-eight (38) per cent.; the leg thirty-two (32) per cent. One-sixth of the deaths were from pyæmia; and there were four cases of tetanus. Such were the results during the first five years of a new and well-equipped hospital. Nor was this sad record much at variance with the other great hospitals.

During the sixth and last period of five years (1889 to 1894), being the experience from this hospital when twenty-five years old to thirty years, although the beds had increased from two hundred and fifty (250) to eight hundred (800), the number of amputations had fallen from one hundred and thirty-two (132), the first five years, to eighty-two (82). Of the one hundred and thirty-two (132), the first five years, the total mortality was forty-nine (49) per cent.; but of the eighty-two (82) amputations, the last five years, the total mortality was sixteen and three-fourths (16¾) per cent.; one-third as large as thirty years ago. Amputations of hip, 50 per ct., instead of 100 per ct.; amputations of thigh, 12½ per ct., instead of 56 per ct.; amputations of leg, 13½ per ct., instead of 32 per ct.; amputations of arm, 16½ per ct., instead of 38 per ct. In other words, few compound fractures came to amputation; of those few the mortality was less by two-thirds than formerly. What other adequate cause can be found for so vast a change unless it be asepsis? The patients were of the same class; the accidents were the same; the hospital wards the same; many of the surgeons the same.

In curious confirmation of these proofs of asepsis come a series of recent events which is a crucial test.

Late in November, 1896, a sudden move of the entire surgical plant to the new operating rooms was made, and made unexpectedly, on account of the urgency of a contractor engaged to tear down the old amphitheatre by December first. New hands had to be employed in a part of the sterilizing process; a new sterilizer was also being tried; everything was thus altered from its habitual use for months previously. Failure of asepsis promptly followed. Stitches suppurated; stitch abscesses burrowed; thirteen cases of absorption, covering the three surgical services, occurred; some serious cases of sepsis; so that all but emergency cases were refused operation.

An "emergency committee" of three surgeons proceeded to hunt for germs, three to six hours each day; and in this they were vigorously assisted by Doctor Councilman's department. Cultures from silk, from cat-gut, from gauze, from sheets, from instruments, were made; more than one hundred in all. The search was immediately rewarded by finding streptococci and spores in the sutures, ligatures, towels and sheets; the gauze, which was baked separately, was free and sterile. The fault was largely in the too low temperature of the new sterilizer. An entirely new bacillus was found in the cat-gut, which produced abscess in the guinea pig when injected in its culture. A spore-bearing bacillus was found on the sheets used at operations. This yielded only to two bakings, twenty-four hours apart. If baked at short intervals it was not killed, because this spore was found to hatch and grow in twenty-hour intervals.

In one week of hard work the trouble was nearly subdued; and soon the wounds resumed their usual course of primary aseptic healing. It was a demonstration, and perhaps worth what it cost.

This brings us naturally to consider the first great advance

in the new surgery. And that is, that under its dressings, we can safely wait, after an accidental injury, an indefinite time, before operating.

All older surgeons must recall the precept, then imperative, that while we might wait after an injury for reaction to succeed shock, we must not wait too long. There was a golden moment, between twelve, eighteen, at most twenty-four hours after an accident, when amputation must be done. Unless this golden moment was availed of, then surgical fever succeeded reaction; suppuration invariably ensued; and while inflammatory processes were going on, and until pus flowed freely, no operation should be done. This intermediate stage was a fatal stage, prone to tetanus, to sepsis, to metastatic inflammation. The necessity of operating on the second, third or fourth day after a wound, in our late civil war, explained the large mortality from tetanus and gangrene which resulted.

Operate early, or operate late; primary amputation within twelve hours of the injury; or, after a week to ten days, secondary amputation on a case become pathological by suppuration. Experience proved this to be the true method.

Under the new surgery all this may be done away with. The lacerated limb is shaved, scrubbed, irrigated, packed and dressed aseptically. One may wait indefinitely; suppuration does not ensue; fever and absorption will not occur, provided the antisepsis is complete; and provided the limb is not fatally injured and past repair.

Wait and see how the injury will turn out. Wait and see whether the parts can heal of themselves and save the limb. Wait in the surety that when you take down the dressing the cuts will look as fresh and clean as when they were inflicted. Under this aseptic *regime* then we wait for shock to be all gone; we wait to see if a compound fracture cannot heal itself. The majority do heal, and amputations become rarer and rarer.

Next, healing is painless. This is a new thought. After the subsidence of the pain of the incisions, lasting a few hours, there should be no more pain in aseptic healing. The clinical thermometer should barely rise, if it rise at all.

Late experiments at our hospital have proved that surgical fever, so called, steadily diminishes as asepsis improves. Imperfect asepsis, a few germs in the dressings, or an infected suture, surgical fever; fair asepsis, no more germs than the vitality of the tissues can handle and destroy, slight fever; perfect asepsis, no stitch abscess, no effusion or draining, no surgical fever, and painless healing. It is a demonstration; and it has been demonstrated.

Contrast this with the course of events formerly, after the removal of a breast. Surgical fever; fifteen ligatures to come away; drainage by the ligatures; suppuration; a daily dressing; a sinus; probably some stitches suppurating and failing to hold; a granulating surface, drawn together with adhesive plaster; fever; pain; ligatures to be pulled daily. Such patients recovered; but they suffered for several weeks.

To take a perfect case of new surgery. A lady, whose breast I removed, told me, after she recovered, that she had had no pain. Ether first annulled it; and she declared she had had no real pain in the dressings, or in healing. This is an extreme case.

The new surgery does away with secondary hemorrhage; why? because the ligature does not come away, but stays on the vessel. Ulceration through the coats of the artery is not to be expected, as formerly; hence the vessel does not give way and bleeding follow. We tie the carotid and the wound heals over the buried ligature of boiled silk, or asepticized animal tendon, by first intention. The vessel is closed when the string is tied; it stays closed, and there is the end of it.

Could John Hunter rise and admire this new use of the

ligature to treat an aneurism, near the sac, with no fear of secondary hemmorrhage; could Ambroise Paré only see his ligature safely enclosed and encapsuled in the stump of an amputated thigh. Primary union; a smooth scar; no pain; no hemorrhage; no suppuration.

These triumphs of asepsis in ordinary wounds seem small, however, in comparison with what it has accomplished in visceral surgery. Opening serous cavities with impunity, and with a mortality for simple exploratory cœliotomy of from three to five per cent., seem to the older surgeon almost incredible. Formerly the abdomen was a hidden and sacred region; now it is thrown wide open. If it is safe to open the abdomen, then it is idle to wait for the growth of cysts of the ovary, but better to remove them before adhesions form. If it is safe, why not remove the appendix when it is not acutely inflamed? Such are the claims of asepsis—we cannot assent to them all, however.

To take another region; in the first five years of the City Hospital fractures of the vault of the skull were equally fatal (60 per cent.) whether trephined or not. Now trephining is used with comparative safety to explore for clots; to remove ganglia; to search for tumors; even to relieve pressure. The pleural cavities and the pericardium have also been opened, as never before.

The value of explorations has been much increased hy anæsthesia. This is the result of, first, absence of feeling on the part of the patient; and second, of the relaxation of the muscles. No question of diagnosis and possible operation on the contents of the abdomen, or of the pelvis, should be considered settled without an examination under ether. The gain in knowledge, and the enhanced accuracy in diagnosis, are very great. Bi-manual examination of tumors of the abdomen, and of the pelvic organs in the female, is made easy and reliable by ether. The rectum, also, is thus rendered accessible.

Many are tempted by the immunity of aseptic surgery to incise the abdominal walls for diagnosis. While explorations are thus made needlessly, still the final risk may be only of a scar, or a hernia. Grave reasons should be the only excuse for such incisions; and while we are spared the former risk of sepsis, still if the explorer disturbs, or handles malignant disease, the subsequent danger is considerable. Chronic peritonitis of the tubercular variety yields the best results from exploratory laparotomy and drainage; but acute, diffused peritonitis is as fatal as before the days of asepsis.

In orthopedics, in opening joints, and in the radical cure of hernia, asepsis has substituted the open incision for the more clumsy subcutaneous methods of Dieffenbach. While atmospheric air was once recognized as hostile to primary healing, it is now proved to be harmless, provided clean hands, instruments and sponges touch the wound.

Antiseptic spray is abandoned as a needless precaution. The knee-joint is safely opened to wire a broken patella; and the *évidement*, or the excision of joints, formerly the pride of the conservative surgeon, is now boldly advanced from a justifiable risk to a certain success.

The golden stitch of Paré, revived by Wood in the subcutaneous suturing of the abdominal rings, has given place to the free, open incision and dissection of Bassini, in the radical cure of hernia.

Club-foot and tarsal deformities are cut open and repaired; and knock-knee is chiselled into shape, without fear or scruple.

The sensitive serous lining of the spinal canal is dissected, pared and matched, to enclose a spina bifida. Fracture and dislocation of the spine is made compound, and repaired with questionable audacity, uncertain result, but yet with aseptic triumph. Hydrocephalus is tapped and microcephalus expanded, by the same surgical boldness without fatality, but without final cure.

The sensitive ganglion of Gasser is torn from its hiding place, with a mortality of only twenty per cent., but with little lasting benefit.

But when we look at the successful treatment of large, open surfaces caused by burns, we must yield our unqualified admiration. Who has not seen, twenty-five years ago, the burn so large it could not heal. The wretched victim perished from chronic irritation. Now skin-grafting and transplantation freely and aseptically cover the largest granulating area with a new epidermic shield; and healing takes place without disastrous cicatrices and contractions.

The treatment of gangrene, traumatic, diabetic or senile, has been much improved. High amputation in traumatic gangrene is now justified, without waiting for a line of demarkation, since sepsis, in this moist variety, frequently outruns the walling off of nature. And the aseptic and buried ligature has enabled us to amputate the atheromatous vessels of age and senile mortification, with a fair degree of success.

The curetting of cold abscesses and packing them with antiseptic gauze have hastened their repair, and proved curative; but only provided the source of suppuration could be removed, as in a joint. Meanwhile the flaxseed poultice has been replaced by hot fomentations of corrosive gauze, thus checking pus formation in acute abscess. Pus is still brought into hospitals; but little pus is engendered in them. Hospitalism is a myth, where once a terror.

It may be confidently asserted that grave surgical injuries and operations are safer in a hospital than in their own homes, however luxurious. Sanitation, scrupulous cleanliness, discipline, drill, ceaseless vigilance, skilled nursing, night as well as day attendance of trained care-takers, and above all antiseptics and asepsis, have brought about this marvellous success.

Pyæmia was the opprobrium of surgery and the fatal

disease of hospitals. Sepsis decimated the lying-in retreat. Both are so far subdued, that suppuration and absorption are regarded almost as a fault; and puerperal blood-poisoning as a neglect of due precaution, in many instances. This is a strong assertion, and may be questioned, but statistics answer for it, to a large degree.

But when we approach the large class of chronic diseases, we are forced to pause in our enthusiasm. Tubercle, cancer and sarcoma are, as yet, unconquered. Setting aside the inoculations of Koch, and regarding only the treatment of tubercle by the knife and gouge, it is not yet proven that evident tubercle, as in lymphatic glands, should always be removed. Neither pulmonary nor miliary tuberculosis always follow tuberculous glands in the neck, if left untreated. Many children grow up and have long lives, whose so-called scrofulous glands have scarred their necks by suppuration in their early years.

"It is a familiar clinical fact, that the operative treatment of joint tuberculosis has not infrequently been followed by tuberculosis of other organs, or by general miliary tuberculosis."*

Cancer is a degeneration; it is senility, often premature. Could a germ be found, an antitoxin might succeed. Cancer spreads; becomes disseminated; attacks other tissues. New cancer grows in the lymphatic glands, and in other parts. "The reproduction of similar structure is an argument against the microbic orgin of cancer."†

Cancer is an atypical proliferation of cells from a matrix of embryonic epithelial cells. The new epithelial cells, like the amœba and leucocyte, possess the power of locomotion, or migration. Here is the fatal fact, and the reason for dissemination. We see cancer cells sprinkled like dust over the mesentery and peritoneum in abdominal can-

* Senn, "Limits of the Art of Surgery."
† Ditto—"on Tumors."

cer. Generalization of cancer takes place in consequence of the entrance into the circulation of cancer cells, or fragments, which when arrested, like emboli, constitute new centres of cancerous growth. It is this cell migration, and the intrinsic capacity of the cells to reproduce themselves in new localities, that constitute malignancy. For example, in eighteen cases of cancer of the pylorus, Senn found only one case limited to the pylorus; in seventeen the lymphatic glands were also affected.

Here operation could be only palliative, and not curative. Nodules in the skin and in the lymphatics are the rule of dissemination in cancer of the breast. Later, one may be sometimes attracted by an arching out, or prominence of the sternum, on the affected side. Here we may suspect cancer in the medulla of the sternum. The bronchial and mediastinal glands are next involved; then the pleura and the liver. Obviously the surgeon's knife can only be curative in those early or exceptional cases, where the misplaced cells are local, and have not migrated. All operations, however extensive, at a later period, must be wholly uncertain as cures; and recurrence is the rule, sooner or later.

Sarcoma is an atypical proliferation of connective tissue cells. The small round cells migrate freely through the muscular interspaces, by the sheaths of the vessels, through the vessels, rarely by the lymphatics. Sarcoma gives rise to regional or general infection at an earlier stage than cancer. It is vascular and rapidly growing. Hence a very early operation is the only thorough one. Local recurrence is more common than general.

Sarcoma is the tumor of young and vigorous life; cancer, the degeneration of senility; tubercle hatches in the nest of childhood and adolescence. We have here, then, three diseases incurable by the knife. Anæsthesia and asepsis may charm, but they will not cure. We have to

look for a different class of remedies:—the erysipelas toxin; the streptococcus toxin; chemical solvents? What, we know not yet. But through this path only can finally be secured immunity from occurrence, recurrence and death from these malignant affections.

While admitting freely the great benefits sometimes conferred by judicious surgeons, yet the New Surgery is in danger of injury and degradation from the tendency to over-operate. This is a very grave charge, but it is true.

We can open the abdomen safely; why not look in, nor wait for halting diagnosis? Having looked in, if we find anything operable we remove it. A healthy appendix; a fibroma, or a cyst like a marble; a drooping uterus to hang up; a sinning ovary to rebuke, and take out of the way of farther mischief.

We leave Nature no chance. But be sure she will get even with us in the end. The expected relief from removing pelvic organs does not always follow. The sensibilities of nerves cut away are referred back to their terminal branches, as we see in amputations. Neuralgia, menstrual nisus, flows of serum, supplement the normal function. The patient is unable to work, and is, moreover, unhappy. Meanwhile Nature teaches us, by her laws of compensation, that an operation is not always necessary. A dilated bladder overflows; an obstructed bowel leaks by serous diarrhœa, and the unbearable load is washed away. So time and physiological rest will often alleviate the ills of pelvic indurations and inflammations.

Will operations increase in frequency? We think not; but there will be a conservative reäction that will tend to diminish them. Also, the advance in bacteriology will diminish them still more. Traumatic surgery we shall always have; but pathological surgery will be lessened by new anti-toxins. Meanwhile we must not overlook the changes which the New Surgery is causing in the surgeon

himself. First, he is specialized. Necessary preparation and special study are so much increased, that he must pay attention to surgery only to be successful. Second, his responsibility is increased with his knowledge. The electric light pierces opaque tissues, and clarifies a diagnosis, before doubtful; or shows misplacement in a fracture, so that the dullest juror can see it. The anatomy of the viscera opens up a new field of study for the surgeon. He operates no better than his predecessor, but he must know more.

Surgery is less simple than formerly. When to operate in appendicitis, and when to forbear, open up a new set of anxieties for the surgeon; redness, heat, pain, swelling, fluctuation, guided the knife formerly; now leucocytosis and the thermometer must also be consulted.

The surgeon of today needs general professional training first, so as to promptly recognize and treat any medical complications, such as pneumonia, pleurisy, the exanthemata. Next, clinical experience to appreciate gross appearances. Then, regional anatomy; training in bacteriology; a competent knowledge of the mechanical and chemical details of asepsis. Restrained by broader knowledge and with a judgment tempered by experience, the new surgeon will offer to the world only such operations as are nearly sure of success; thus benefiting the public health, which was the object of its founder in endowing the Shattuck Lectures.

ARTICLE XXII.

ON THE OCCURRENCE OF RETINAL HEMORRHAGE AFTER MIDDLE AGE: AND ITS BEARING ON THE DURATION OF LIFE.

By HASKET DERBY, M.D.
OF BOSTON.

READ JUNE 8, 1897.

ON THE OCCURRENCE OF RETINAL HEMORRHAGE AFTER MIDDLE AGE: AND ITS BEARING ON THE DURATION OF LIFE.

THE history of the following case will serve as a fitting introduction to the present paper.

Mr. X. Y., aged sixty, consulted me a few years since. From having had excellent vision for objects both far and near, assisted of course in regard to the latter by glasses corresponding to his years, he had only recently come to notice a considerable difference between the two eyes. On testing him in regard to this point I found that, while the vision of the left eye was normal, with the right eye he could barely count fingers held ten feet away. There was no external change, but the ophthalmoscope showed the presence of innumerable spots of fresh hemorrhage into the retina, scattered over the entire field, as well at its periphery as in the immediate vicinity of the nerve.

Mr. Y. had been for years actively engaged in public life, had not long previously undergone much excitement and fatigue in contesting an important election, and had only recently acted as counsel in a protracted and excited trial. He was a man of large frame and full habit, weighing probably two hundred pounds or more. He paid no attention to physical exercise, and had for three years enjoyed no vacation whatever. Numerous affairs of consequence were even then engrossing him.

I felt justified in assuring him that the disease of the eye was probably the forerunner of something worse, unless he wholly changed his course of life. Weakened retinal implied weakened cerebral arteries, and it was easy to realize what that meant. I advised complete rest for several months, as well as a change of surroundings.

The patient viewed the situation intelligently, and talked it over for an hour, dwelling on the absolute necessity of keeping his numerous professional engagements, and the consequences that might ensue from any neglect on his part of the important interests that had been confided to him.

This was in July, and I never saw him again. A year from the following February he came out of the court-house, in which he had been trying a case, started to walk home, but quickly grew confused, staggered, and had to be placed in a carriage. He grew rapidly insensible, manifested all the signs of an attack of apoplexy, never regained consciousness to a full extent, and died on the third day.

The subject of the connection of retinal hemorrhage with the condition of the general health is not dwelt upon by writers on ophthalmology at any length. I have looked over all the accessible literature that has appeared since the invention of the ophthalmoscope, and have been surprised to find how little is said in regard to the matter. The subject is ordinarily dismissed in a few words. All authors are, however, agreed that, occurring in the aged, the symptom is an ominous one. While its effect on sight need be but temporary, capable as it is of a considerable measure of repair, and ordinarily affecting only a single eye, it has a bearing on the duration of life that is full of significance. It may betoken an atheromatous condition of the cerebral arteries, and be due to a similar state of things in the retinal vessels, which, however, the ophthalmoscope fails to detect. Or there may be a cardiac lesion, ordinarily hypertrophy of the left ventricle.

Thus the symptom is one of great importance, and the prognosis serious. The detection of the disease is easy for one who has a moderate acquaintance with the examination of the interior of the eye. The cases themselves are far from infrequent. And the warning given by their occurrence may be practically utilized for the regulation of important business interests. Life itself may often be prolonged by abstinence from exhausting labor, by appropriate relaxation, and the following a suitable regimen.

I am not aware that a series of these cases has ever been followed up, and the result given to the profession. Many difficulties lie in the way of such an undertaking. The ophthalmic specialist differs from the family physician in his ability to keep track of his patients. With many, indeed it may be said with most, a single interview is all that is had. People come from points more or less distant for the purpose of consultation, and on obtaining an opinion return to their own adviser. It is very hard to learn anything relating to their subsequent history.

During the past two years I have gone over all the cases of retinal apoplexy I could find in my records, and endeavored to obtain fresh intelligence in regard to them. By correspondence with relatives and physicians, as well as occasional reference to the obituary columns of the daily press, I have in some instances been enabled to follow them along. Out of ninety I have succeeded in tracing the course of events in only thirty-one. The youngest of these patients was 43, the oldest 83, the average age being therefore slightly above 62.

Beginning with the youngest I have arranged a tabular statement as follows:

1. Male. Aged 43. Very large single hemorrhage, of sudden occurrence. In five weeks vision had wholly returned. Fourteen years later patient alive and well.

2. Male. Aged 45. Numerous fine hemorrhages scat-

tered over entire fundus. Patient, hitherto engaged in active and engrossing business, gave it up entirely and, from this time forward, led a life of comparative leisure. But the attacks recurred from time to time, and he died of cardiac disease sixteen years later.

3. Female. Age 46. In right eye extensive hemorrhages, scattered over macular region, as well as remote parts of fundus. A single splash of blood in other eye. Vision had been for several months observed to be imperfect. Her family physician reported "cardiac hypertrophy, a systolic murmur, and irregular action." Eighteen months later she was seized with convulsions, became unconscious, and died the next day.

4. Female. Age 46. Numerous small scattered retinal apoplexies at periphery of fundus in one eye. Vision had been obscure for several months. Examined by Dr. Knight she was found to have well marked aortic regurgitation. Six months later she had embolism of right hand, two days later of right foot, death supervened in a few days.

5. Female. Age 47. Dark, red spot of blood directly over macula in one eye. Previous notes show that, ten years before, two small hemorrhages had been seen near the optic nerve, in the other eye. Dr. Knight examined the heart at that time, and found it normal. The hemorrhages disappeared. Four months after the last attack patient died of apoplexy on a railway train.

6. Male. Age 48. Vision of left eye impaired for three weeks. Numerous small spots of hemorrhage in macular region. Vision one eighteenth. Sight was ultimately regained, in great measure, and the patient was reported well fourteen years later.

7. Male. Age 49. Very large, fresh hemorrhage just above optic nerve of one eye. Patient much overworked, made to relinquish business and take a journey. Recovery complete, well four years later.

8. Male. Age 56. Blur over right eye for six weeks. Large hemorrhage found near nerve, also numerous smaller ones at periphery of fundus. Some improvement took place, though sight was never completely restored. Died of paralysis two year later.

9. Female. Age 58. Sudden failure of vision in one eye, numerous fine retinal apoplexies found scattered over fundus. Died of cardiac disease nineteen years later.

10. Male. Age 59. Small retinal hemorrhage in one eye. Died suddenly of apoplexy, in his state-room on a steamer, about two years later.

11. Female. Age 59. Vision of one eye suddenly fell off several months ago. Numerous small retinal hemorrhages scattered about macular region. Ten months later died of apoplexy.

12. Male. Age 59. Within two weeks great failure of vision in each eye. Dilated one pupil and found numerous retinal apoplexies. Other eye similarly affected, as nearly as could be seen through the small pupil. This was in August, and patient died of paralysis the following winter.

13. Male. Age 60. (Case quoted at commencement of article.) One eye affected for two weeks, enormous number of fine apoplexies. Examined in July; a year from the following February fell in the street with an attack of apoplexy, and died in three days.

14. Female. Age 60. Failure of sight for two months, due to retinal hemorrhages. Eighteen months later died suddenly of apoplexy.

15. Female. Age 62. Numerous retinal hemorrhages in one eye, with corresponding failure of vision, the whole lasting six weeks. Two years later was reported to be in good health, but died of apoplexy seven years afterwards.

This patient was a sister of case 6.

16. Female. Age 62. Within six weeks rapid failure

of vision of each eye. Large hemorrhages in each retina. Patient was six months under observation, and the hemorrhages repeatedly recurred. Is reported to have died of heart disease three years later.

17. Male. Age 63. Several bright splashes of blood near lower edge of optic nerve. Had noticed trouble with eye for a week. This was the middle of March. April 9 a fresh hemorrhage was observed to have taken place. May 8 he fell dead of apoplexy, while sitting at his desk.

18. Male. Aged 65. Dimness of one eye observed for a month. A number of small blood spots over macula. His physican wrote concerning him that he had valvular disease of the heart, apparently at aortic orifice, together with enlargement. Case terminated fatally in less than two months.

19. Male. Aged 65. A very large number of small retinal apoplexies in macular region, of recent occurrence. No apparent cause. Vision much impaired, but was subsequently regained, and patient was well and hearty seventeen years later.

20. Male. Age 66. Sudden appearance of spots of retinal apoplexy over macula of one eye. Vision never returned; patient died suddenly of apoplexy three years later.

21. Male. Age 66. In November, 1876, hemorrhages near right optic nerve; in April, 1877, fresh attack; in 1881 the other eye became similarly affected. In August, 1883, died of apoplexy while sitting at the table.

22. Male. Age 70. In May, 1874, there were several small fresh hemorrhages over left macula. In 1884 patient was in good health, though vision had not returned. In 1890 is reported to have died of "old age."

23. Female. Age 70. Retinal hemorrhages in each eye, right affected a year, left three weeks. Three weeks later died suddenly of heart disease.

24. Male. Age 72. Vision of one eye greatly impaired for six months. Numerous retinal hemorrhages. General health excellent. Two and a half years later saw him again, no return of vision, health as before. Two years afterwards had an apoplectic seizure, and at the end of two years more died of paralysis.

25. Female. Age 73. One eye only affected, and that within a few days, great failure of vision, hemorrhages scattered over fundus. Patient reported to have cardiac trouble, but no opportunity for examination was offered. Five months later died of heart disease.

26. Male. Aged 73. Visison of left eye had been imperfect for a few months. Extensive retinal apoplexies. Two years later had paralysis of the left side, and two years after that died of uræmia.

27. Male. Aged 74. For two months has observed what he terms a "black ball" before one eye, with much failure of sight. Retinal hemorrhages scattered in all directions. A year later died of apoplexy.

28. Male. Age 76. Right eye affected two weeks, large patches of freshly effused blood in retina. Four years afterwards died of apoplexy.

29. Female. Age 76. Extensive retinal hemorrhages around periphery of left fundus, failure of vision being quite recent. Nine years later died suddenly of heart disease.

30. Male. Age 78. Four days ago noticed failure of vision in left eye. Numerous bright splashes of blood surround optic nerve entrance. Came from his physician with a diagnosis of cardiac disease, there being a mitral murmur. Died of heart disease a year later.

31. Male. Age 83. Left eye had failed for three years, vision now restricted to distinguishing moving hand. Large spot of effused blood over macula. Sight never returned, but the patient lived on six years, and died finally of inflammation of the bladder.

We have here then a total of thirty-one persons, between the ages of forty-three and eighty-three, subjects of retinal hemorrhage. Twenty-five of these died after brief illnesses, some indeed with the utmost suddenness. Eleven of this number died of heart disease, fourteen of apoplexy. Five were at last accounts living, their average age being fifty-four, and their cases followed up an average of thirteen years. Another, a man of eighty-three, died six years after he came to me, of an affection of the bladder.

While therefore the effusion of blood in the retina cannot be said to uniformly portend danger to life, it has certainly a grave significance, increasing directly with the age of the patient. That it is often overlooked there can be no question. Within a few days I received a visit from a lady aged seventy, who had consulted me fourteen months before. The eyes were then examined separately, both as to vision and ophthalmoscopically, and found to be in the condition that would be expected at her time of life. She saw distant objects with either eye equally well. On the occasion of her second visit she complained that the use of her glasses had of late been attended with difficulty, and that she found it impossible to support the continued use of the eyes on near objects. She came supposing that she needed a change of glasses. One eye remained normal, while the vision of the other had fallen off nine-tenths, and there were numerous retinal apoplexies. Of the occurrence of this accident she had not the least idea. Unwilling to alarm her I stated the case to the daughter who accompanied her, gave directions for the treatment of the patient, and wrote to her son, advising a speedy arrangement of any unfinished business matters.

And this is the practical point involved. An early diagnosis, and the consequent recognition of the possibility of sudden death, not only leads to the settlement of business interests that, in the event of an unexpected demise, might

seriously suffer; but causes advice to be given that may sensibly prolong the days of the patient. Auscultation, thus suggested, may detect the presence of an hitherto unsuspected cardiac lesion. And in any case suitable diet, leading a regular life, and above all the avoidance of exhausting work or excessive mental activity, have lengthened many a life thus threatened. I cannot doubt but that, if the patient mentioned in the commencement of this paper had followed the advice that was earnestly given him, had retired from his engrossing and exhausting work and taken the vacation he so much needed, a valuable and valued life might have been long preserved to the community. He was a man of powerful physique, and apparently in the prime of his powers, both bodily and mental, when the apoplectic seizure, of which he had had full warning, came so suddenly upon him.

These cases must of course be referred back by the specialist to the family physician, to whom indeed their diagnosis ought to be by no means impossible. The patient is generally advanced in years, vision is suddenly impaired, and in a single eye, a general mist or blur being the symptom complained of. Cataract makes its presence more gradually felt, while glaucoma can be recognized by the tension of the eyeball, the enlargement of the pupil, and the characteristic encroachment on the visual field. If there is no reason to suspect either of these diseases, a retinal hemorrhage is, under the circumstances already mentioned, at least probable. To enlarge the pupil, which is ordinarily necessary, a weak solution of scopolamine may be used, and the degree of familiarity with the ophthalmoscope, which now does or should enter into the training of every physician, enables the observer to make a certain diagnosis.

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ARTICLE XXIII.

ANOMALIES OF MUSCULAR BALANCE.

By OLIVER F. WADSWORTH, M.D.
OF BOSTON.

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ANOMALIES OF MUSCULAR BALANCE.

In the short time allotted to me I can hope to give but a brief and imperfect sketch of my subject. And it must be admitted that the problems involved in the action of the ocular muscles and our attempts to remedy their deficiencies are by no means fully solved. Still, knowledge in this direction is gradually increasing.

The class of anomalies of which I am to speak does not include such faults of balance of the ocular muscles as cause an evident deviation of one eye, as in strabismus. Whether the want of balance be due to a preponderance of strength of one set of muscles over their antagonists, to a faulty position of the attachments of the muscles to the globe, or some other cause, the essential element in these cases is that the proper direction of the two eyes with regard to each other is habitually maintained, although at the expense of abnormal or excessive exertion on the part of one or more muscles.

The existence of such cases has long been recognized; the terms insufficiency of interni or externi to define them and of muscular asthenopia to denote the fatigue occasioned were long employed. As these terms imply, it was mainly to want of balance between the internal and external recti that attention was directed, and the condition was studied chiefly as it affected the efficiency of the eyes for near work. In the last ten years however a wide-spread interest in the subject has been aroused in this country, and it has become manifest

that not merely are these defects of balance more frequent, but the functional disturbances to which they may give rise are more numerous and of greater variety than was formerly recognized, while their effects may be seriously felt in distant as well in as near vision.

As men are constituted it was only to be expected that extravagant assertions should be made as to the importance and deleterious influence of these anomalies. Indeed it seems to have been the publication of such assertions that first stimulated the recently awakened investigations. We are all of us cognizant of isolated cases in which a comparatively slight cause has produced grave functional disorders, but that is far from establishing a general law. A case of spastic torticollis which had persisted for years and was rapidly cured by the division of one of the superior recti muscles, I reported in the "Transactions of the American Ophthalmological Society," in 1889, but it does not follow that many cases of torticollis are of similar origin. The claim that a large proportion of cases of epilepsy and chorea owe their inception to faults of ocular balance, or to errors of refraction, or to both combined, and may be cured by the correction of these causes, has been sufficiently disproved.

The usual symptoms caused by imperfect balance of the ocular muscles are fatigue of the eyes, headache, which may be located at any part, but in my experience is most commonly referred to the back and base of the skull, vertigo and nausea. Even vomiting occurs in some cases, not dependent on severity of the headache. Occasionally there are vicarious sensations. One of my patients complained of a coppery taste on use of the eyes, which sometimes lasted throughout the following day. Dizziness in some cases is excited by moving objects and brought on by driving, or riding in the cars, or walking in a crowded street. In most instances the symptoms are not different from those

with which we are familiar as caused by errors of refraction, and it may be said in passing that errors of refraction are much the more common source of such symptoms.

The defect of balance may be such as to incline the eyes to converge or to diverge, or to incline one eye to be directed higher than the other. And the latter defect may occur in combination with either of the others. The terms proposed by Dr. Stevens to denote these conditions have proved very useful. Thus esophoria denotes a tendency to convergence, exophoria to divergence, and hyperphoria a tendency of one eye to point higher. We say right or left hyperphoria according as the right or left eye tends upward. The amount of the defect is measured by the strength of the prism required to correct it.

There is general agreement that the conditions in which one eye tends to point higher, hyperphoria, is much more disturbing then esophoria or exophoria. And the reason for this is not far to seek. The natural ability of an eye to turn upward or downward with reference to the other in order to maintain binocular single vision is much less than its ability to turn relatively inward or outward for the same purpose. Fortunately, hyperphoria is much less common. Whether disability more frequently occurs from esophoria or exophoria there is not the same unanimity of opinion. My own experience leads me to the belief that exophoria is the more usual cause of trouble. Esophoria is indeed the more common, but a given degree of esophoria is of less consequence than the same degree of exophoria. On the other hand, it is not very uncommon to find an esophoria of so large amount that, if the defect of balance were in the opposite direction there would almost inevitably be frank divergence, and hence no exophoria. For, as has been said, that a case should be classed among these affections both eyes must, in spite of the lack of muscular equilibrium, maintain the proper direction.

The position of balance in the primary position of the eyes, *i. e.* when the head is erect and the eyes are directed straight forward toward the horizon, is usually different, so far as the lateral muscles are concerned, from that which exists when the eyes are directed somewhat downward and to a nearer point, as in ordinary work or reading. Formerly, in considering the question of balance the condition found at the reading distance was generally regarded as of main importance. Now, while the state of the balance at the reading distance is not to be neglected, chief emphasis is placed on the condition when the eyes are directed horizontally and to a distant object. Both theory and practice indicate that the latter view is the more accurate.

The methods now employed for the detection of faulty equilibrium are modifications and improvements of tests long in use. To describe them would make too great a demand on the limited time at my disposal and lead me into technicalities which I wish to avoid. It should be said, however, that in every case careful correction of errors of refraction should precede the examination of the muscular balance, and such examination should be made only while the glasses which correct any errors of refraction are worn. Only under this condition can the tests be considered reliable.

The means of treatment are mainly two—the wearing of prisms and tenotomy of the preponderating muscle. The first is but palliative and suffices to correct the defect only when it is of moderate degree, since prisms stronger than 4° or 5° cannot be worn with comfort on account of the color dispersion they produce, and for other reasons. If the amount of the defect is comparatively small, prisms may be sufficiently effective. And if, because of accompanying errors of refraction, glasses are to be constantly worn in any event, the addition of prisms may answer every demand. With higher degrees prisms can only partially correct; yet partial correction may give comfort.

The radical treatment, tenotomy, when successfully employed, offers decided advantages. By tenotomy alone can the greater defects be even approximately corrected, and although with lesser defects prisms may be efficient it is only on the condition that they be worn constantly, and this is often a not inconsiderable inconvenience. Yet the performance of tenotomy is not to be lightly undertaken. In the conditions with which we have here to do its amount must be determined with the utmost care, and not even the operation for cataract demands more skill and judgment on the part of the operator. Above all, the desired effect is not to be exceeded. An individual who all his life has been training a set of muscles to act in an abnormal way to overcome the defect, will, if he is suddenly called on to make those muscles act abnormally in the opposite direction, although in less degree, probably be in a worse state than he was before. It is decidedly better therefore to stop short of the total effect desired rather than to run the risk of exceeding it. And an operation that only approximately corrects is often all that is necessary. But if too much effect is unintentionally produced, the excess should always be immediately corrected, or even somewhat over-corrected, by bringing the severed tendon forward with stitches. To fulfil these requirements intelligently every tenotomy should be done under the anæsthesia of cocaine, never under ether.

The exact amount of the defect it is not always easy to determine. The application of the tests for its discovery requires judgment and experience and should be repeatedly made before a definite opinion is formed. As, in the state of refraction known as hypermetropia, the ciliary muscle, constantly called on to act to excess whenever any effort of vision is made, is often unable to fully relax when a glass neutralizing the hypermetropia is placed before it, so here, the muscle trained to excessive action often does not abandon such action readily and the true balance does

not become apparent. It is therefore almost invariably better, even if tenotomy seem advisable, to precede it by the use of prisms for a few weeks. In this way we may learn something of the effect of at least a partial correction on the symptoms, and we not infrequently find that the defect is greater than at first appeared. It is, I believe, in great part owing to this inability of the muscle to readily give up its habit of excessive action that, in some cases, a few days or weeks after a tenotomy its immediate effect is found to have apparently diminished. Rarely the reverse occurs, the result of an operation which is at first satisfactory proving after a few days to be somewhat too great. Sometimes this excess disappears again after a time spontaneously. If it does not the tendon must be brought forward.

The number of persons in whom some want of equilibrium of the ocular muscles exists is very great. In the vast majority of them, however, the amount of the defect is small, and when it concerns only the lateral muscles, as is usually the case, is seldom of any importance. Moderate defects of balance in the muscles that raise and depress the eyes, and higher degrees in the lateral muscles, may and often do cause serious functional disturbances and require correction either by prisms or tenotomy.

It need hardly be added that in many cases the condition of the eyes is only one factor in the causation of the symptoms, even when these are the more common ones of ocular fatigue and headache, but it is none the less a factor to be reckoned with, and the correction of it alone many times will bring relief.

ARTICLE XXIV.

SOME PHASES OF LACHRYMAL OBSTRUCTION, AND THEIR TREATMENT.

By DAVID HARROWER, M.D.
OF WORCESTER.

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SOME PHASES OF LACHRYMAL OBSTRUCTION, AND THEIR TREATMENT.

AMONG the most annoying and persistent trouble that we have to treat in connection with the eye, we find those of the tear passage not the least. The lachrymal secretions come from the lachrymal gland and from the conjunctiva and pass through the superior and inferior puncta into the passages that lead into the sac, and from that into the lachrymal duct and empty into the nasal fossa below the inferior turbinated bone. At the spot where the lachrymal sac passes into the nasal or lachrymal duct, is the point where we are liable to have most of the pathological obstructions that occur. In its course the lachrymal duct passes backward and outward from the vertical, the entrances to the ducts being nearer together than the exits.

The cases of lachrymal obstruction that present themselves for treatment are the acute, and chronic. In the chronic case, the patient comes complaining of epiphora, or tears running over the lids and generally of a swelling in the region of the lachrymal sac; perhaps the swelling may be painful and tense, and often as big as a walnut. Sometimes when pressure is made on this swelling the contents consisting of pus and mucus can be forced out through the puncta—or more rarely through the nose. The immediate cause of this condition is some obstruction of the nasal duct. The tears can no longer find an exit into the nose, and begin to accumulate in the sac, which becomes more and more distended. The tears soon become decomposed

and start an irritation of the mucous membrane lining the sac, which then undergoes an inflammation throwing out pyoid secretion which mixes with the tears in the sac. The contents thus grow more turbid and resemble pus.

Constrictions of the nasal duct may come from inflammation of the mucous membrane in the nose, simple chronic catarrh, or of a scrofulous or syphilitic origin. The swelling of the mucous membrane may extend by continuity to the mucous membrane of the duct. In the ordinary forms of ozæna there is no swelling, but cicatricial contraction of the nasal mucous membrane, which may lead to the constriction of the inferior orifice of the duct. Ulcers of the mucous membrane and polypi are also causes of obstruction at the nasal orifice.

The course is long, extending often years if nothing is done for it. The secretion that at first was purulent becomes mucous and viscid, the mucous membrane may atrophy and the distended sac contain nothing but tears, but the epiphora still remains.

A person suffering from this chronic form may have an acute attack of inflammation suddenly develop. The skin over the sac becomes reddened and greatly swollen, the swelling often extending to the lids, and to the conjunctiva which may become chemotic. There is generally a great deal of pain, so much so that the patient is deprived of sleep. After a few days the skin at the apex shows a yellowish point and becomes perforated, the pus discharges and the swelling gradually disappears. Afterwards pus followed by mucus, and later tears are discharged. As long as this fistula remains open the patient is safe from another attack, but if it closes up a recurrence may ensue.

In the treatment of the milder forms in which epiphora is the most annoying symptom we should always examine the nose, and if any trouble is found there it should be treated. Often uncorrected errors of refraction are a cause,

and should also be carefully looked after. Suitable washes where there is only an irritation of the lachrymal tract are often of great benefit.

The large majority of cases are only benefited by operative treatment, and this, in my opinion, is best accomplished by a complete division of the stricture and the use of large probes. In all cases, acute or chronic, I operate as soon as it is possible to pass my knife straight into the sac, that is if the parts are not too much displaced by the swelling. If there is too much swelling I use hot applications, and wait for a chance to let the pus out. Generally a day or two after this is done the duct is in such a condition that a proper opening can be made. I always use a Weber knife with a long shank, and Theobold's probes. I make the incision in the ordinary way. I insert the probe pointed end in the lower punctum with the knife straight up, then depressing the knife down and out 90 degrees, and with the cutting edge turned slightly toward the eyeball, I push forward until the point touches the inner wall of the sac. I then bring my knife up perpendicular, and holding it lightly but firmly, pointing slightly backward and outward, push it straight down until it reaches the floor of the nose. I then pull it back, turn it a quarter of a circle and push it down again, withdraw it nearly again and turn it a quarter more and cut again, and still once more, making four cuts down through the stricture. This is all done very quickly. I then pass the largest Theobold probe I can into the nose (generally a 12. or 14.), bandage up the patient's eye and send them home, giving them a wash of boracic acid, dilute hydrocyanic acid, cocaine and water, to use freely. I probe the two following days with the same sized probe I used on the day of the operation. Then I probe every other day for the next week, then twice the next week, and once the next; then again in two weeks. This generally suffices, although not always. If they need any more pro-

bings I am very apt to use a slightly smaller probe, especially if they have been three or four weeks without having any probe passed. I *never* leave the probe in. I pass it and immediately withdraw it.

In making the incisions in the stricture and dilating we have a certain amount of exudation thrown out into the cuts; this cut is again forced open the next day, and at each succeeding probing, and another chance for a new exudate given. In this way when we are done with our probing, we have or should have four cicatrices that retract rather than contract, and leave us an opening through which tears can pass. The extended sac will generally diminish and return to nearly its normal size, or near enough to cause no further trouble.

When we have a largely distended sac that will not contract, there is ordinarily nothing left but extirpation or cauterization. No one will claim that all cases of epiphora or lachrymal obstruction can be cured. We have too many that are apparently just as badly off when they leave off treatment as when they began. I certainly think that the free incision of the stricture and the proper probing afterwards will do more in my hands than any other method that I have used.

ARTICLE XXV.

CONTAGIOUS CONJUNCTIVITIS.

By MYLES STANDISH, M.D.
OF BOSTON.

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CONTAGIOUS CONJUNCTIVITIS.

CONTAGIOUS conjunctivitis, strictly speaking, embraces all the more acute forms of conjunctivitis, but in this paper I intend to treat more particularly of the group usually spoken of as purulent or blennorrheal conjunctivitis. In this group there are four principal classes; 1st, the acute catarrhal conjunctivitis, commonly called pink eye; 2d, ophthalmia neonatorum; 3d, gonorrhœal conjunctivitis; 4th, diphtheritic conjunctivitis.

Under these heads there have been grouped in the past four distinct clinical pictures, which may be briefly summarized as follows:

1st. Acute catarrhal conjunctivitis. A disease of the conjunctiva in which there is great congestion, some swelling of the lids, and more or less muco-purulent discharge. The cornea is rarely infiltrated and the disease runs its course in from eight days to three weeks. The eye upon recovery is unharmed.

2d. Ophthalmia neonatorum. A disease which appears within the first week of the child's life, being characterized by a profuse purulent or muco-purulent discharge with congestion of the conjunctiva and often very considerable œdematous swelling of the lids, the cornea often becoming infiltrated, necrotic, with sloughing of the corneal tissue, leaving dense, white cicatrices, which make the child blind for life. That this much to be deplored result occurs only too often is demonstrated by the fact that nearly 20% of

all the blind under twenty years of age become so from this cause.

3d. Gonorrhœal conjunctivitis. An acute disease produced by an infection with gonorrhœal pus, marked by great congestion of the conjunctiva. Œdematous swelling of the lids, often very great, and characterized by a profuse flow of creamy pus, yellow without mucus, which is sufficiently liquid to flow easily down the cheek upon the opening of the lids. The cornea generally becomes seriously infected, with sloughing of the corneal tissue, and perforation as a common result.

4th. Diphtheritic conjunctivitis. An acute disease marked as the previous ones have been by great congestion of the conjunctiva, which in the course of a few days is succeeded by a deep, grey, brown infiltration, which produces in the lids a brawny, inflexible condition, so that the upper lid apparently elongates and hangs over the lower lid down upon the cheek. This brawny, brown, grey infiltration also extends onto the conjunctiva of the eye to the margin of the cornea. There is no discharge except some lachrymation in which are occasional flakes of false membrame. The cornea soon becomes necrotic, sloughs, and the eye is lost.

The above descriptions have been classical for years, but in the light of modern bacteriology must be modified very considerably, and a new nomenclature which follows the bacteriological findings, must be adopted. Such a classification of purulent ophthalmias would place some cases, which from the above description would be classed as gonorrhœal, under the head of diphtheritic conjunctivitis, and some cases which would formerly have been classed as acute catarrhal conjunctivitis prove to be gonorrhœal, and so on. In all cases this scientific accuracy of diagnosis may not be of importance, but in others the safety of the eye depends upon an early and accurate determination of

the micro-organism present. I have, with the assistance of Dr. William Daly, made an investigation of all acute cases of conjunctivitis coming on my last two services at the Massachusetts Charitable Eye and Ear Imfirmary, and this paper is a summary of the result of that investigation.

The first thing to be noted is that the disease known as acute catarrhal conjunctivitis is in reality a group of a number of mild infections often produced, it is true, by a bacillus, which has been described by Dr. Weeks of New York; nevertheless, it may apparently also arise from an infection with the pneumococcus, staphylococcus, streptococcus, and perhaps by other micro-organisms, not excluding an infection with gonococcus, which may run so mild a course as to be mistaken for some of the other infections, although such instances are rare. A bacteriological investigation of ophthalmia neonatorum shows that almost all the cases which run a destructive course are due to an infection with gonococci, although within a few weeks I have seen a case in which a purulent conjunctivitis, originating within the first week of life, was due to an infection with Klebs-Lœffler bacilli. The lighter cases of this disease have in my experience proved to be due to an infection with pneumococci. The fact that the majority of these cases are gonorrhœal has made the success of the Credè method for the prevention of this disease.

In cases which present the clinical pictures of diphtheritic and gonorrhœal conjunctivitis, experience has proved that bacteriological examinations are of the very greatest value, for many cases, which from the clinical picture we have supposed to be gonorrhœal are, in reality, diphtheritic and the converse is also true to some extent, as I have seen brawny aud infiltrated lids, dense infiltration of the bulbar conjunctiva with necrotic condition of the cornea and very slight, if any, purulent discharge, which upon bacteriological investigation proved to be infections from gonococci.

From the standpoint of therapeutics, it is of greatest importance that a proper bacteriological diagnosis should be made in these cases and that from this examination the line of treatment should be decided, and not from the clinical appearance of the eye. The importance of this early diagnosis is, to my mind, due to the fact that in gonorrhœal ophthalmia nitrate of silver is the only application which ever controls the disease, while in diphtheritic conjunctivitis I consider that nitrate of silver hastens the destructive process which is taking place in the corneal tissue. Conversely, it is my opinion that the diphtheritic condition of the conjunctiva and consequent necrosis of the cornea will generally be controlled by prompt and persistent use of antitoxine.

After these infections of the conjunctiva, the next most dangerous form of contagious conjunctivitis is the so-called granular lids or trachoma; if this is of bacterial origin the micro-organism has not as yet been recognized, nevertheless it will spread slowly through an orphan asylum, tenement house, or any other place where the poor are crowded together, unless special means are taken to prevent this result, leaving its victims handicapped for life and often nearly blind. Fortunately it is diminishing in this country and is, compared with a few years ago, seldom seen except among recent immigrants from the eastern end of the Mediterranean, Polish and Russian Jews, Armenians and others from that locality, and I may say in passing that the presence of acute trachoma in the conjunctiva of immigrants should be a good and sufficient reason for turning them back whence they came. A large proportion of these cases within a few months after their arrival become incapacitated and are public charges. And not only this, but were it not for the new cases thus introduced into the great tenement localities of our large cities, it is my opinion that the disease would soon become extremely rare in this part of the country.

From my experience in cases of purulent conjunctivitis and trachoma, I arrive at the following conclusions:

1st. That in all cases of purulent conjunctivitis, the diagnosis should be made by the bacteriological examination and not from the clinical picture.

2d. That in the two most dangerous diseases of this class, viz: gonorrhœal conjunctivitis and diphtheritic conjunctivitis, a favorable outcome of the case depends upon a correct diagnosis, as proper treatment in one disease is of no benefit in the other and may even do harm.

3d. That in cases of ophthalmia neonatorum a bacteriological diagnosis is as important as in other cases of purulent conjunctivitis, and if such were made early and prompt treatment instituted, many a child would be saved from blindness.

4th. That in every case in which a parturient woman has a leucorrhœa, if it is not convenient to bacteriologically determine the cause before the birth of the child, Credè's method should invariably be employed.

5th. Immigrants with acute trachoma should not be admitted to this country.

ARTICLE XXVI.

CONVERGENT STRABISMUS.

By CHARLES H. WILLIAMS, M.D.
OF BOSTON.

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CONVERGENT STRABISMUS.

THE nerve centres which govern the accommodation and convergence of the eyes are closely related both in position and action; an increase of accommodation carries with it an increase of convergence, and *vice versa;* and a disturbance of this equilibrium is one of the principal causes of convergent strabismus.

In Donder's experiment a person with normal eyes looks steadily at a near object; a screen is then placed between this object and one eye, but no deviation takes place in the convergence of either; if, however, a concave glass is placed before the other eye an increased amount of accommodation will be needed in order to see the object clearly; the eye behind the screen will then be seen to turn more strongly inward in proportion to the increased effort of accommodation, while the eye with the glass remains fixed on the object. This condition is similar to that of young hypermetropes who are beginning at an early age to make use of their eyes for near vision. They require an amount of accommodation in excess of the convergence needed for seeing near objects, and if one of the eyes for any reason has less acuteness of vision or muscular power, as compared with the other, we often get a resulting strabismus; on the other hand there are hypermetropes of all degrees in whom strabismus never develops, and many cases of deviation must be accounted for by amblyopia, by impaired muscular balance, or primary anomaly of binocular vision.

Out of 612 cases of operation for convergent strabismus, reported by Dr. C. S. Bull,* 521 had simple hypermetropia and 58 hypermetropic astigmatism; my own experience does not give quite so large a proportion as this, but all observers agree that the percentage of hypermetropia in cases of convergent strabismus is very large. In the early stages of the trouble the deviation is often periodic or alternating, becoming in time more permanent, and it is during these early stages, while binocular vision can still be called into play, that we should endeavor to effect a cure; that is, get parallel visual axes, and, if possible, permanent binocular vision. If the treatment is delayed we may obtain a good position of the eyes by operation, but we very seldom get good vision in the squinting eye. Schweigger states that he has never seen any improvement in vision in a squinting eye after an operation, or even after separate exercising; and the reported gain is often due to the correction of errors of refraction rather than to the operation.

Convergent strabismus is usually developed in childhood, in some cases even before the second year, but in these very early cases, and in a few others, we often get a spontaneous cure; it is more common to have it first noticed in children of from 2 to 5 years of age, occurring when the child is tired or excited, or when the system is weakened by an attack of whooping cough or other disease; and, if neglected, these attacks will often become more frequent and the convergence more permanent. Before deciding on our plan of treatment we should note the amount of deviation, its permanency, the effect of atropine on the convergence through its effect on the accommodation, and the refractive condition of the eyes as shown by retinoscopy or the upright image. If the patient is old enough to give reliable answers we should also ascertain the acuteness of vision of each eye and the relative power of the internal and exter-

* Transactions Am. Ophthalmological Society, 1895, p. 261.

nal recti muscles. In general it may be said that it is not best to operate on children under six years of age, and not before the effect of atropine and glasses have been carefully tried; but the best results will often be obtained in children of from six to eight years of age, where the deviation has not yet become permanent, or binocular vision lost. If under atropine the eyes are found to be hypermetropic a nearly full correction with glasses should be given as soon as the child is able to wear them, even as young as four years of age, and the effect of the atropine should be gradually diminished while the glasses are worn. It has been found that about ten per cent. of the cases can be cured by optical means; but the success is closely related to the age of the patient and the care with which this treatment is carried out. The best measure of the strabismus is to get the angular deviation of the eye with a perimeter; but a rough estimate can be made by holding a millimeter rule at the margin of the lower lid of the squinting eye and noting the difference in the position of the centre of its pupil when the other eye fixes a distant object in front of the patient, or is covered so that the squinting eye fixes it; one millimeter will correspond to about 5° of angular deviation. If after a thorough trial of the optical treatment no improvement results it will be necessary to resort to operative measures, which is the final outcome of a majority of the cases, especially in adults. In most cases of periodic squint a simple tenotomy removes the trouble, especially if the deviation does not exceed 20°, and it is a common rule that one tenotomy will give about 15° of change in the deviation of the eyes. It is best to leave a *slight* convergence as the first result of the operation, for there is a tendency toward increased effect after a time, and a slight convergence will often pass into a practically parallel position. Noyes states that for a deviation of from 5° to 15° only one eye is to be operated on; from 15° to 30°, both will

require it, but there should be at least a two weeks' interval before the second operation; for more than 30° both eyes may be done at the same sitting. In cases of permanent convergence the squinting eye, or in alternating cases the one which usually squints, should be first operated on. If there be marked deviation, especially with considerable amblyopia, and weakness of the external rectus of the squinting eye, it will often be best to make a tenotomy of the internal rectus and also an advancement of the tendon of the external rectus of the deviating eye, and if the result is not sufficient a tenotomy of the internal rectus of the opposite eye can be done at a later date.

During the last ten years a number of operators, especially Landolt and de Wecker, have recommended advancement instead of tenotomy in many of these cases. The advantages are that by advancement of the weaker externus when the internus has normal power, we add to the power of the externus and give it a better hold, without taking away from the power of the normal internus, and the eyeball is also left in a better position for rotation. The advancement operation is not so simple as the tenotomy and requires a longer after treatment to get the tendon of the externus to take hold firmly in its new position. The conjunctiva is incised near the cornea vertically and dissected up from the externus muscle which is then grasped with the forceps near its insertion and a small cut made at its lower border through which a blunt strabismus hook can be passed under the muscle. The muscle is then raised from the sclera and two sutures are passed through it and its surrounding tissues far enough from its border not to tear out easily. The tendinous attachment of the muscle to the sclera is then divided between the sutures and the eyeball, and while the eye is rotated by an assistant toward the cut muscle, the sutures are carried through the superficial layers of the sclera near the cornea to get a firm

hold, and tied. The conjunctival incision is then brought together by fine stitches and a binocular bandage applied. The patient should remain in bed for five or six days, when the sutures can be removed, but the bandage should be continued for two days more to allow the healing to take place with as little disturbance from muscular contraction as possible. In advancement operations there is a tendency to get increased effect by the contraction of the cicatrix, and my brother wrote me last winter from Berlin that they were beginning to have there cases in which this contraction had produced so much deviation as to require another operation to remedy it. This, however, seems to be rather an excess of advancement in the earlier cases similar to that which occurred after the first tenotomies, producing an over effect, and does not contra-indicate the operation. The treatment of strabismus does not end with the operation; it is necessary to continue the careful correction of refractive errors with glasses, and often to supplement the glasses with orthoptic exercises which may train and strengthen the muscular action and help the maintenance of binocular vision.

Many cases of convergent strabismus are perplexing; it is often difficult to decide what operation will give the best results, or how much must be done to produce a given amount of alteration in the convergence as a final result, and we must not be disappointed if cases are found which need more than one operation, or in which we have to rely on our best judgment rather than on fixed rules.

ARTICLE XXVII.

PURULENT OPHTHALMIA FROM THE BACTERIOLOGICAL STANDPOINT.

By WILLIAM J. DALY, M.D.
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PURULENT OPHTHALMIA FROM THE BACTERIOLOGICAL STANDPOINT.

THE importance of an early bacteriological examination in purulent conditions of the conjunctiva has already been pointed out. The clinical picture in such conditions is oftentimes, it may be said in the majority of cases, of no value in helping us to determine the ætiological factor, it being absolutely impossible in some cases to distinguish clinically in the beginning between

Acute contagious conjunctivitis,
Diphtheritic conjunctivitis,
Pneumococcus conjunctivitis,
Membranous conjunctivitis, not due to the presence of the Klebs-Lœffler bacillus.

Another class of purulent cases in which the differential diagnosis without microscopical examination is one of great difficulty is that offered by the infants seen for the most part in out-patient departments of large hospitals. Here is to be made a differential diagnosis between

Gonorrhœal ophthalmia,
Tear sac disease from pneumococcus infection,
Acute contagious conjunctivitis (rarer).

The bacteriological examination attendant upon the successful diagnosis of these cases may be said to be divided into two parts:

I. The examination of the smear.
II. The examination of the growths upon culture media.

The technique of the examination is very simple and con-

sists in the preparation of the smear in removing from the conjunctival sac a small amount of the discharge with a platinum wire which has previously been heated in the flame of an alcohol lamp or Bunsen burner, then cooled in the water of condensation of a sterilized tube, and spreading the discharge in a thin layer upon an ordinary microscope slide.

This layer is then fixed by gentle heating in the flame and a few drops of Lœffler's alkaline methylene blue poured upon the slide. It is again passed through the flame, washed off with water and dried slowly in the air or by warming.

That the smear is an important step will be readily appreciated by the statement of the fact that many cases of diphtheritic conjunctivitis (and from the experience of the last year and one quarter in the laboratory of the Massachusetts Charitable Eye and Ear Infirmary during the different services, notably that of Dr. Standish, over fifty per cent., approximately estimated, of all such cases) can be diagnosticated immediately, and the eighteen to twenty-four or more hours' delay attendant upon culture development obviated.

It is also possible to recognize in this manner every case of gonorrhœal conjunctivitis, although in these cases a second step is essential, which consists in bleaching the micro-organism with the Gram stain, as some intra-cellular diplococci are found resembling the gonococcus which are associated with conjunctivitis and with a marked discharge, and which on treating with the Gram stain do not bleach.

The results of repeated observations upon the characteristics of this organism warrant the statement that it is the micrococcus subflavus with which one has to do.

That the early diagnosis by means of the smear is a boon to the physician who possesses an oil immersion lens, is apparent.

The second part of the bacteriological procedure in purulent conjunctivitis consists in the examination of the growths obtained by the inoculation of the different culture media from the conjunctival sac discharge.

In the consideration of the bacteriological appearances in these conditions, it would be better to confine the description to the appearances in the smears, as the recognition of the colonies on the culture media, and the demonstration of the bacteria from the culture tubes on the slide or cover glass, is a simpler matter than the demonstration of the organism in the smear. Incidentally it may be said that during the course of this investigation a large number of cultures were made from the conjunctival sacs of healthy individuals who exhibited no ocular trouble, and although a number of articles have been published, especially in the German journals, to the effect that all healthy conjunctival sacs contain bacteria, the experience here showed that in a large number of cases (in some series 50% or more) the tubes showed absolutely no growth, the culture media used being, for the most part, blood serum, and occasionally gelatine and agar-agar.

In the order of importance from the prognostic standpoint, diphtheritic conjunctivitis is entitled to first consideration. Proceeding as described, a piece of the membrane or a slight amount of the discharge is transferred to the slide and stained. With the aid of an oil immersion lens are made out the brightly stained nuclei of the leucocytes, the fibrine strings and meshes and clumps of conjunctival epithelium.

In the fibrine meshes and in the conjunctival cell clumps are for the most part the bacilli, lying in groups, oftentimes of eight or ten, and exhibiting the typical characteristics of club-shaped ends, and clear unstained spaces in the rod. In marked cases the membrane may be stripped off and sections made with a freezing microtome. These sections

are stained with Gram's stain for bacteria in tissues, and show the bacilli lying along the edges of the membrane in large quantities.

Membrane formation of such size is, however, not the rule. The gray, thin membrane occurring in patches on the palpebral, and less often on the ocular conjunctiva, is the form of this disease that generally comes to the practitioner's notice. In such cases, if the sterilized platinum wire be rubbed along the surface of the false membrane, the typical picture may be obtained in the smear.

In this connection, it would be well to state that a small number of cases have been noticed associated with decided membrane formation, in which the staphylococcus aureus was found on repeatedly taken cultures, and which in a few days cleared up wholly and without corneal involvement.

In considering the appearances in gonorrhœal ophthalmia, the smear alone is to be relied upon, as it is next to impossible and certainly impracticable to grow this organism upon the surfaces of the ordinary culture media. A small quantity of the discharge having been spread upon the slide, is first stained with alkaline methylene blue, and the presence of intra-cellular diplococci ascertained. Another such slide is stained with Gram's stain, which consists in first coloring with aniline oil water gentian violet, washing with water, and then treating with the iodine, potass. iodide solution of Gram, again washing with water, finally with alcohol, and drying.

Under such treatment the cells lose somewhat of their sharp outline, but the principal change is in the organism; the dark-colored diplococcus losing its intensity, is seen as a bleached, oftentimes rose-colored, organism, within the cell outlines, and characteristically grouped. The degree of the bleaching of the gonococci is in a direct proportion to the length of time that the bleaching reagent is allowed to remain upon the slide, and may be carried so far as to

render the diplococci nearly invisible. It is often possible in this manner to demonstrate the invasion of the large hexagonal and becher cells of the conjunctiva by this organism.

A specific infection of the conjunctiva by the pneumococcus sometimes followed by corneal complications seems to be, from the number of cases seen, well established. Under such circumstances the discharge is thin, and may or may not be profuse. Generally it is poor in cellular elements, and shows here and there in the smear single pneumococci. The cultures from such eyes show small pneumococcus growths.

In those forms of pneumococcus infection associated with tear duct disease in young children, both the clinical and microscopical pictures are striking. In many of these cases it is impossible to tell clinically in such children whether we have to do with a gonococcus or pneumococcus infection.

The microscopical pictures presented by smears, however, are widely different. Here the pneumococci are found in large numbers, the discharge is profuse and containing fibrine-like strings. The appearances are enhanced by a capsule stain, and exhibit a different microscopical picture from that offered by the pneumococcus infection in the adult. In the cultures, large growths of pneumococcus are formed almost to the exclusion of other organisms.

Regarding the microscopical observations in acute contagious conjunctivitis, there is at present some doubt. Dr. Weeks, of New York, claims a specific bacillus in the bacterium bearing his name. He postulates that it is to be found in every case of this disease. The experience in the bacteriological laboratory of the Massachusetts Charitable Eye and Ear Infirmary does not bear out this assumption. In some few cases the organism that he describes has been found, exhibiting upon culture media the same biological characteristics, and in the smear being identical with those

in smears made by Dr. Weeks himself, and kindly lent by Dr. Standish.

The vast majority of all such cases, however, show the commoner pyogenic organisms both in the smear and growth, viz: the staphylococci, streptococcus, and in some few other cases the bacillus xerosis and the bacillus pyocyaneous.

The object of this communication is principally to call attention to the fact that in those cases of contagious conjunctivitis where the clinical diagnosis in the beginning is difficult or impossible, the possessor of a good microscope may ascertain the infection with which he has to deal, thus promoting early treatment, and using the cultures as a means of control.

ARTICLE XXVIII.

SOME OF THE GENERAL PRINCIPLES WHICH SHOULD GOVERN OPERATIONS FOR OTITIC BRAIN DISEASE.

By J. ORNE GREEN, M.D.
OF BOSTON.

READ JUNE 8, 1897.

SOME OF THE GENERAL PRINCIPLES WHICH SHOULD GOVERN OPERATIONS FOR OTITIC BRAIN DISEASE.

THE otitic brain diseases are four:

Pachymeningitis externa with extra-dural abscess,
Leptomeningitis or arachnitis,
Encephalitis or brain-abscess,
Phlebitis and thrombosis of the sinuses and jugular vein;

all caused by infections from the ear, the microbes being the same varieties as are found in the suppurating ear-cavities, chiefly streptococci, staphylococci and pneumococci.

The proportion of deaths from otitic brain disease to deaths from all other causes and to the total number of inhabitants is given in Table 1, taken from Körner.*

Prussian statistics for 1885.

FREQUENCY OF DEATHS FROM OTITIC BRAIN DISEASE.

AGE.	TOTAL INHABITANTS.	TOTAL DEATHS.	TOTAL.	IN 10,000 LIVING.	PER CENT. OF ALL DEATHS.
0–10	7,110,695	371,323	811	1.14	0.22
10–20	5,726,644	26,130	1,346	2.35	5.15
20–30	4,625,908	33,516	1,291	2.79	3.85
30–40	3,596,465	38,269	553	1.53	1.44
Above 40	7,456,231	247,621	536	0.72	0.21
Unknown	2,527				
	28,518,470	716,859	4,537		0.63%

* Die Otischen Erkrankungen des Hirns, der Hirnhäute und der Blutleiter.

The relative proportion of the different otitic diseases is shown in Table 2.

COMPARISON OF OTITIC BRAIN DISEASES.

Sinus Phlebitis and Pyæmia,	Körner	41	Pitt 22	63
Brain Abscess,	"	43	" 18	61
Meningitis,	"	31	" 15	46
		115	55	170

The proportion of otitic to other meningitides is shown in Table 3.

MENINGITIS.

In 9,000 Autopsies:

Otitic Meningitis,	15 = 0.16%
Tubercular Meningitis,	162 = 1.8 %
Meningitis from other causes,	133 = 1.48%
	310 = 3.44%

About 5% of all meningitides are otitic.

Pitt.

The causes of brain abscess are given in Table 4.

BRAIN-ABSCESS.

In 9,000 autopsies, 56 cases, produced by

Diseases of Ear and Temporal Bone,	18 = 0.2%	
" " other cranial bones,	8	
Trauma,	9	
Pyæmia,	9	
Lung-Disease,	8	
Unknown,	4	
	56 = 0.62%	

About one-third of all brain abscesses are of otitic origin.

Pitt.

The causes of sinus phlebitis are given in Table 5.

SINUS PHLEBITIS AND THROMBOSIS IN 9,000 AUTOPSIES:

Forty-four cases, produced by Disease of Ear and Temporal Bone,	22 = 0.24%
Other Suppurations near Sinus, tumors, pyæmia,	4*
Carbuncle,	3
Trauma,	7
Debilitating Diseases,	8*
	44 = 0.48%

Two-thirds of all Sinus-Phlebitides due to disease of ear and temporal bone.

Pitt.

After these tables I would call attention to Table 6.

DEATHS FROM SUPPURATION OF THE EAR.

In 9,000 Autopsies:	57 = 0.6 %	= 1–158.	Pitt, Guy's Hospital.
" 8,028 "	45 = 0.56%	= 1–178.	Three London Hospitals.
17,028	102	0.6 % = 1–167	
In 33,017 Ear patients,	104 = 0.3%.		Bürckner.
" 5,000 " "	15 = 0.3%.		Randall.
38,017	119	0.3%	
In 325 Tympanic Suppurations,	4 = 1.2 %.		Bezold.
" 1,137 Tympanic Suppurations,	10 = 0.88%.		Chauvel.
" 8,425 Tympanic Suppurations,	35 = 0.4 %.		Schwartze.
" 820 Tympanic Suppurations,	20 = 2.4 %.		Barker.
10,707	69 = 0.64%		Körner.

*Ten of these simple thrombosis without phlebitis.

With all of the otitic brain diseases, except arachnitis, aseptic surgery has dealt successfully.

Statistics of operations for sinus-phlebitis, Table 7.

OPERATIONS ON LATERAL SINUS.

	Cured.	Died.	Total.
With ligation of jugular,	26 = 63.4%	15 = 36.6%	41
Without " " "	16 = 42%	22 = 58%	38
	42	37	79
Ligation before evacuation of sinus,	19 = 68%	9 = 32%	28
Ligation after evacuation of sinus,	6 = 60%	4 = 40%	10
Ligation without evacuation of sinus,	1 = 50%	1 = 50%	2
Ligation between beginning and end of sinus,	0	1	1

Cause of death in the above thirty-seven cases:

Pyæmia with lung-abscesses,	12
" without lung-abscesses,	5
Leptomeningitis,	11
" and pyæmia,	3
Brain-abscess,	2
Shock,	1
Not determined,	3
	37

Statistics of operations for brain-abscess, Table 8.

OPERATIONS OF BRAIN-ABSCESSES.

	Cured.	Died.	Total.
Cerebrum,	42 = 55.3%	34 = 44.7%	76
Cerebellum,	9 = 56.25%	7 = 43.75%	16
	51	41	92

In these 92 cases, multiple abscesses in 8 = 8.7%.

Körner.

Certainly this is a very favorable showing for diseases in which the prognosis is desperately bad without surgical interference, and in which medicine is absolutely powerless; but these statistics must not be regarded as showing the actual proportion of cures and deaths, for many cases of operation, especially the unsuccessful ones, are never reported. A careful study of the individual reports does, however, show recoveries in apparently the most desperate cases of all of the diseases, except arachnitis, which is universally regarded as beyond surgical relief. It also shows that the earlier the operation is done the more likely success will result.

This brings up directly the question of diagnosis, both pathological and localizing. In none of these brain diseases is there any one or any combination of characteristic symptoms which enables us to make a positive pathological diagnosis in every case. Almost all symptoms are occasionally seen in two or more of the diseases, and in a large proportion of cases the full complex of symptoms which makes up the clinical picture and enables us to give a reasonably positive diagnosis only appears a few hours before death, when the vital forces are too exhausted to justify surgical interference. Positive localizing symptoms are in a very large proportion of the cases absolutely wanting throughout the disease, for the portions of the brain in direct relation to the ear, those parts where the otitic brain disease occurs in almost all cases, contain no centres for mobility or sensibility, and only the centres for amnesic aphasia and perhaps the centre for hearing in the opposite side; while the only cerebral nerves likely to be involved early are the seventh (facial), and eighth (auditory), and an affection of these nerves occurs so often from the tympanic disease that they are of no value for cerebral localization.

I would not be understood as undervaluing the very accurate description of the clinical symptoms of these diseases

which we possess in some of our recent works, nor the wonderful progress which has been made in cerebral localization; but I do believe clinical experience already teaches that if we wait for a complete pathological and localizing diagnosis, many cases will be lost which might have been saved if justification had been found for an early operation. Are we then justified in operating on a suspected diagnosis merely?

The otitic brain-diseases are usually due to the suppuration of the ear cavities affecting the bone which lies against the dura.

Table 9.

DISEASE OF THE BONE.

		Bone Diseased to Dura.	Diseased, but not to Dura.	Bone Healthy.
Sinus Diseases,	39	32 = 82%	3 = 7.7%	5 = 10.3%
Brain-Abscesses,	40	37 = 92%	1 = 2.5%	2 = 5.5%
Meningitides,	30	17 = 57%	4 = 13.3%	9 = 29.7%
	109	86 = 79%	8 = 7.3%	15 = 13.7%

Körner.

The recognition of this fact, that the bone is diseased directly to the dura in 79 per cent. of the cases of otitic brain-disease, constitutes one of the most important advances of our knowledge within the last few years. It gives us justification for early exploration of the bone, and as disease of the bone originates from suppuration of the ear, the ear is the cavity from which the bone should be explored, if this is possible, *i. e.*, we should follow the disease inwards from its source.

The frequency with which the dura is exposed in mastoid operations and found healthy, although lying in direct contact with diseased bone, shows that it is a membrane not easily infected; on the other hand mastoid operations, with

removal of all carious bone, not infrequently lead one into the cranium and reveal extensive pachymeningitis which had given no symptoms, or show phlebitis and thrombosis of the lateral sinus which had also given no symptoms because the thrombus had not yet broken down and infected the general system. Clinically it often happens that with a suppurating ear we have symptoms which we are confident are to be referred to the brain, and yet with the most careful study are unable to say whether the disease is in the cerebrum or in the cerebellum, whether it is pachymeningitis, phlebitis or brain abscess. By exploration of the bone these doubts can be solved, and we are in position to immediately and early treat the brain-disease, and also remove the diseased bone which, if left, is liable to reinfect the brain tissues. Given a suppuration of the ear with symptoms, however slight, pointing to the brain, open the ear-cavities and explore the bone. This can be done in most cases by a tympano-mastoid exenteration which exposes the entire roof of the tympanum, aditus and antrum, and also the inner wall of the mastoid; but in exceptional cases this operation is impossible owing to osteo-sclerosis of the mastoid, to the tympanic roof lying very low, or to unusual projection outwards of the sigmoid groove. In these exceptional cases the bone must be exposed directly; the tympanic roof by entering above the linea temporalis, the inner mastoid wall by removing the mastoid. In the twenty-one per cent. of cases in which the bone is not diseased up to the dura the same rules for operating are applicable, for the chances are still that the brain disease is in close proximity to the temporal bone. The only exceptions are the very rare cases of abscesses in the first (upper) convolution of the temporal lobe, or the still rarer cases of abscesses in the frontal or parietal lobes which require operation directly over their situation; and for the recognition of this situation we must depend upon the whole complex of symptoms and the established rules of localization.

To summarize what I have endeavored to express briefly and without elaboration on account of the short time allowed:

(1) In otitic brain disease early operation is advisable, but an early exact diagnosis is often impossible.

(2) The chances are 79 in 100 that a fistula through the bone from the ear will lead directly to the brain disease.

(3) The infected ear requires operation in any case, and this operation can be combined with an exploration for the bony fistula and the recognition and treatment of the brain disease.

ARTICLE XXIX.

THE FATIGUE OF DEAFNESS.

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THE FATIGUE OF DEAFNESS.

THAT impairment of the hearing power should be an inconvenience is readily understandable; that it may make so large a demand upon the nervous energy as to be a source of fatigue, needs personal experience or observation for its full appreciation.

The investigations of Ogston and others show that the middle ear is usually cleared of its protective cushion of tissue with the first cry, and that the infant is apparently sensitive to sonorous vibrations within a few hours after birth.

The education of the brain through the organ of hearing, therefore, begins at a very early period; and the habitual classification of sounds, in reference to their cause, their indicative importance to the individual, and the location of the sound source, is early assured.

The establishment of a perceptive habit implies provision for the expenditure of nervous energy along a given line, deviation from which necessitates a further expenditure of energy proportionate to the degree of deviation from what was formerly the line of least resistance.

Changes in the tension of the sound-transmitting apparatus of the middle ear, and in its sound transmission incident to disease, may so alter or decrease the sounds perceived as to make them unfamiliar and needing explanation by a mental process; and the total or even partial abolition of

the hearing power of one ear, the other remaining intact, may so far interfere with the ability to appreciate the direction of a sound source, which is one of the habits of normal binaural audition, as to be not only a cause of embarrassment but to make a serious demand upon the nervous energy as well.

To the individual possessed of a reasonably perfect machine, the working limitations incident to possible imperfections in that machine are with difficulty appreciable by any merely mental process, and it is therefore only the sufferers themselves or those whose business it is to study imperfections, effect repairs and suggest compensations, that the full cost in expenditure of nervous energy required to overcome an obstacle, either to perception or expression, can be adequately understood.

With the abolition or limitation of one or another of the channels of communication through the human machine, a portion of that nervous energy which is constantly seeking peripheral expression must be expended in the adjustment to the new conditions and the utilization in a compensatory way of other channels of communication.

Given therefore a limitation of sight, of hearing, or of tactile sense, an expenditure of energy in what may be termed the conversion of force is required, which evidences itself in the individual as that complex of symptoms to which we give the name of fatigue; and the purpose of this short communication is to direct attention to one form of the mechanism of force conversion, which is evidenced by what may be called the fatigue of deafness.

In view of the fact that the normal ear has very nearly double the amount of hearing power necessary for the ordinary practical uses of every day life, it is understandable that one-half of the binaural hearing power may be lost without serious inconvenience to the individual; beyond that point of deficiency, however, a distinctly appreciable

effort must be made to hear, and, in default of this, a still further effort to gather through other sensory channels such information as may serve to supplement the defective hearing.

The channel which is especially available for this supplementary purpose is that of sight, because through it there may be brought to knowledge the character of the particular mechanical process originating the mode of motion to our appreciation of which we give the name of sound, and the most important illustration of this visual aid to defective hearing is found in the effort to appreciate the sounds of the voice at their true value.

Human speech is made up of a series of vocal sounds, all within a short compass, which are modified, obstructed or terminated, by changes of position in the articulating apparatus, to the effects of which we give the name of consonant checks.

A superficial study of these checks shows that some of them are formed in the front, some in the middle and some in the back of the mouth; that they are, with few and slight exceptions, accompanied by a greater or less degree of resonance in the nasal and pharyngeal cavity, and that they vary considerably in the amount of muscular energy required for their production; and furthermore, that the principal distinction to the ear between such consonant sounds as are similar in character is due to the greater or less preponderance of a small number of qualitative overtones.

Further than this we are aware that the consonant sounds which nearly resemble each other, in both force and musical value, are produced by the coördinating operation of very nearly the same sets of muscles, and therefore are accompanied by very nearly the same facial expressions.

Given, therefore, an average case of marked impairment of hearing, the result of a slowly progressive middle ear disease, the patient will hear most readily the consonant

sounds which require most force in their production; these include four explodents—t, d, p and b—which very nearly resemble each other in force and tone value; they are however formed in the front of the mouth, p and b being distinctly labial, and t and d as distinctly formed by the contact of the tip of the tongue with the upper incisors. From the position and formation of these consonants and the necessity for distinguishing between them, it usually ensues that their differentiation makes the first step in that instinctive study of lip reading, which to the appreciably deaf person becomes eventually more or less habitual, and which offers another channel for the expenditure of nervous energy in the effort to see, as well as to hear, the spoken word.

The other consonant sounds having the greatest logographic or force value, k and g for instance, are those formed in the back of the mouth, and are accompanied by a lesser degree of recognizable facial expression than the front consonants, while the consonants having the least force value—f, l, n, m, for instance—very nearly resemble in the mechanism of their construction the harder consonant sounds of nearly the same musical value.

It thus comes about that the deaf person will, when a soft consonant occurs in a sentence, substitute for it, mentally, the hard consonant sound most nearly resembling it, which would have been heard had it been used. In any given sentence, therefore, there are to the very deaf, though seeing persons, certain consonant sounds which are distinctly heard, others which are imperfectly heard, others which are detected by sight, and still others which are merely inferred.

In high grades of imperfection of hearing, therefore, both the effort to hear and the effort to see combined are inadequate to the presentation to the mind of the complete spoken sentence, since there remain gaps in the array of consonant sounds which must be filled in judiciously from

the context, and the completion of the sentence thus presented means the solution of a puzzle and a third demand upon the nervous energy in addition to that required to hear and to see.

In other words, the exercise of the ordinary communication with his fellow men demands of the deaf person the operation of three distinct brain processes to achieve that which is normally accomplished without conscious effort, and the resultant fatigue may be justly estimated as a possibly important factor in many cases of nervous overstrain.

ARTICLE XXX.

NASAL OBSTRUCTION, WITH REFERENCE TO AURAL DISEASE.

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NASAL OBSTRUCTION, WITH REFERENCE TO AURAL DISEASE.

To be attributed to obstructed or neglected nasal respiration are not only deformities of the lower part of the face and of the chest, diseases of the teeth, of the mouth, and of the eye, but also many of those of the upper air passages including the naso-pharynx, and last but by no means least of the ear. Of the affections of the latter organ of special sense in this category those most commonly met with are diseases of the middle ear of a catarrhal or inflammatory nature.

Since the discovery of adenoid vegetations in the naso-pharynx by the late Dr. Wilhelm Meyer, of Copenhagen, in 1868, these growths are probably most commonly considered the cause of nasal obstruction; but since the nose has been opened up to us by the discovery of the anæsthetic and constricting properties of cocaine in 1886, it has been found that hypertrophies of the nasal mucous membranes, exostoses, enchondromata and deflections of the septum nasi, not to mention nasal polypi, are also large factors in nasal obstruction.

The principal function of the nose is respiratory, *i. e.*, the modification of the inspired air by warming, moistening and straining so that it shall not be irritating to the mucous membranes of the air passages. That it may accomplish these purposes it is essential that the lumen of the nares shall be free and unobstructed. If this normal con-

dition obtains, the air currents are free and full and no undue air pressure, positive or negative, exercises any evil influence. But if because of trauma or improper development (Roe*) one or both nares become more or less obstructed, a partial vacuum is produced behind the obstruction, which acting like the dry cup tends to produce a hyperæmia which also, as it is more or less chronic, results in a thickening — a hypertrophy or hyperplasia according to its chronicity or the kind of tissue involved. For example, in the soft succulent tissues of early childhood, attempts at nasal respiration during a cold which has occluded the nose, doubtless bring about a hyperplasia of the naso-pharyngeal tonsil; and this is a very probable factor in the etiology of adenoid vegetations. So also an anterior obstruction of one naris causes a negative pressure behind it and hence a deflection of the septum, as shown by Mayo Collier.

In later life the thickened mucous membrane of the naso-pharynx may be due to the persistence of this hyperæmic condition through the habit of mouth-breathing then established, and seldom corrected; or may be brought about by the same modus operandi through partial or complete obstruction caused by hard or soft growths in the nose. This growth or thickening in the naso-pharynx interferes with the proper action of the ventilator of the middle ear, the Eustachian tube. The movements of swallowing, which are more or less constant throughout the twenty-four hours, by means of the actions of the levator and the tensor palati muscles, should so open and close the Eustachian tube that air may be allowed to enter the middle ear, and the secretions of the tube and the mucous cavities beyond may be pumped out, as it were. The tensor palati sends a small band of muscular tissue up into the soft anterior wall of the tube; its name the dilator tubæ (Rüdinger) describes its function. The levator palati, attached to the posterior

* Transactions of the 18th Annual Meeting of the American Laryngological Association, p. 207, *et seq.*

and inferior border of the Eustachian cartilage, when in contraction throws a fold of mucous membrane upward horizontally so as to partially close the mouth of the tube, at the same time stretching its floor; and then by its relaxation exercises a pumping action. That the sulcus behind the Eustachian cartilage (Fossa of Rosenmüller) should be open and clear, and the mucous membrane around and especially below the Eustachian os should not be too thick, seem to be necessary to the proper results of the performance of these muscular movements.

The direction of the intranasal air currents is also found to be important. It has been said that the floor of the nose is the continuation of the Eustachian tube outward, and that the air currents should play directly backward upon the mouth of the tube. That this is not strictly true may be concluded from the observations of Braune and Classen, Goodale and others, which have shown that the air entering the nasal orifices which look downward and slightly outward passes upward, forming whirls and eddies having horizontal axes and so passing through all the meatuses and reaching all parts of the nose. But that this inferior meatus should be patent is nevertheless proved in practice, since it doubtless exercises much influence on the condition of the Eustachian tube, as well as on those catarrhal states of the nose itself characterized by the retention of viscid mucous secretions which are irritating to the surfaces with which they come in contact.

The subjective symptoms of these causes of nasal obstruction, more or less complete, are:

1. A feeling of pressure in the ear, as if it were plugged. If the Eustachian tube can no longer admit air through it, because of its own collapse or because its mouth is occluded by growths or thickening, the air in the middle ear loses 21 per cent. of its volume by absorption of its oxygen. The atmospheric pressure here at the sea level being fifteen

pounds to the square inch, there would be a pressure of more than four pounds upon the M. T. provided the vacuum behind it were complete. But it must be remembered that the M. T. is almost the only movable part of the walls of the tympanum and all the air spaces communicating with it, including the antrum and other pneumatic chambers of the mastoid process, which may contain a large amount of air. If the oxygen of all this air, therefore, cannot be replenished, it is evident that the pressure-feeling has sufficient reason for its existence. This sensation may also be due to abnormal contact of two surfaces in the nose itself, where it is doubtless reflex as is frequently shown by its cessation when this contact is abolished.

2. Deafness due to fixation of the ossicles from simple pressure upon the M. T. This is but an aggravation of the process just described, made more effective by continuance of the external pressure or increase of its force. In these cases in early stages, both the pressure-feel and the deafness may be temporarily relieved by inflation, but it is evident that the relief must be only temporary unless the patency of the Eustachian tube is restored.

3. Tinnitus Aurium. This is a symptom of such varied kind and quality that it is difficult to speak of it with positiveness; but it is doubtless true that often the pulsating, throbbing, hammering, tinnitus is due to one or more of the lesions under consideration, the most evident of which is a mass of adenoid vegetations or of hypertrophic membrane in the fossa of Rosenmüller. The cartilage of the tube seems to act as a telephone to communicate the sounds of the circulation in the dilated arterioles to the organ of hearing. When these lymphatic structures are hyperplastic, it is probably true that similar glands in the vicinity are also hyperplastic or at least hyperæmic, so that those imbedded in the tissues of the side of the pharynx and in the anterior and inferior walls of the Eustachian tube also send

the sound of their aggravated circulation upward through the dense cartilaginous walls to the ear. Moreover, when these glands are increased in size especially by chronic thickening, the ascending pharyngeal artery which runs in the side wall of the Eustachian tube, and sometimes nearer than others, may be pressed upon so as to have the sound of its pulse wave also communicated to the ear. These three causes of pulsating tinnitus are without doubt frequently operative: and it sometimes seems equally sure that an engorged turbinate may produce reflexly the same symptom, but the writer is not yet quite ready to make this assertion.

The hissing tinnitus is more difficult to locate. It is usually considered to be a circulation sound and is probably most frequently attributed to the capillary circulation in a collapsed Eustachian tube; of course we are not now speaking of the noise when due to disturbances of the internal ear, or to inflammatory conditions around the footplate of the stapes. That this tinnitus may be due to the presence of a spur in the nose or to its pressure on neighboring structures, sometimes seems to be the case, though it is difficult to prove; but the removal of such a spur is justifiable for this reason and the immediate cessation of the tinnitus is not to be expected.

4. Pain is rarely a symptom of the slow insidious closure of the Eustachian tube from the causes now under consideration, but is frequently met with in cases where stoppage is brought about by congestions in the nose and naso-pharynx consequent on colds, irritation of dust or bacteria, or other noxious influences which induce increased functional activity of the intranasal structures. Thus in childhood when the naso-pharyngeal space is relatively small as shown by Dwight, a very slight swelling of the adenoidal growth is sufficient to close more or less completely the inner end of the Eustachian tube and so abolish ventilation and

drainage. This is especially true when these growths are situated at the side of the naso-pharynx, notably in the fossa of Rosenmüller itself. And it may be confidently asserted that earaches in childhood almost always occur as a result of the presence of adenoid vegetations—the exceptions being those reflex earaches from dentition and from tonsillitis, and those caused by trauma, and the invasion of micro-organisms.

And in the adult a hyperæmia of the diffuse lymphatic thickening, sometimes called lateral pharyngitis, or of the hypertrophic mucous membrane itself, may cause pain in the same way; and the affection of the middle ear in this early stage is sometimes designated by the name otitis catarrhalis simplex. A persistence of these conditions brings us to the next symptom—

5. Effusion; in which a pain of considerable severity, lasting but a few hours, is followed by marked deafness and feeling of fullness with sometimes peculiar subjective sounds as of crackling paper or the succussion of fluid on quickly moving the head in certain directions, which sounds may often be heard by the observer through the diagnostic tube. Patients suffering from these effusions, which may be mucous but are usually serous, so constantly have also obstructive lesions of the nose and marked thickening of the mucous membrane at the side of the naso-pharynx that these latter conditions must be looked upon as the mechanical causes of the middle ear affection.

A further aggravation of this symptom, as the persistent increase of the effusion, together with the continuance of the stoppage of the Eustachian tube, must result in the 6th symptom, viz.:

6. Discharge from the external meatus because of rupture of the M. T., the discharge being usually serous at the outset and not becoming purulent unless contaminated with pyogenic micro-organisms from without.

And it is here submitted that these three latter symptoms, viz., pain, effusion, and discharge through rupture of the M. T., may be due to purely mechanical causes at the outset, being simply the results of the dry cupping in the vacuum produced by abolition of ventilation; though as hyperæmia gives place to effusion, this is succeeded by inflammation, soon aggravated by the invasion of pathogenic micro-organisms ever waiting to rush in hosts to a field favorable to their destructive work.

The limitations of this paper preclude an exhaustive elaboration of these subjective symptoms and hence they are but briefly considered as dependent on nasal obstruction *per se*, and not upon those affections caused by invasion of bacteria through the Eustachian tube. And it will not be necessary to allude to objective symptoms, since they may be inferred from what has been said; but there is one at least which it may be of service to describe, and that is the appearance of the M. T. In cases where the tube is collapsed or mechanically closed by naso-pharyngeal obstruction this membrane is sunken, of a dark dull bluish color, showing no translucency since there is no air behind it, the manubrium is foreshortened, the short process is prominent, and the light reflex is either abolished or present usually as a minute bright point. This appearance is so constant as to be pathognomonic of this naso-pharyngeal condition, and might be designated as the adenoid ear.

Treatment. The only rational deduction from what has been stated above is that treatment must be directed to the restoration of the proper ventilation and drainage of the middle ear, and that the functions of the Eustachian tube must be restored. To this end causes of the obstruction of its mouth must be removed. Adenoid vegetations should be taken away not only from the vault and the middle of the naso-pharynx but from the sides, and especially from the fossæ of Rosenmüller—a point often omitted in

cases operated upon simply for correction of the evils of mouth-breathing; and many a case of persistent deafness aggravated by colds, and of persistent purulent discharge from the ear may be apparently cured at least so far as these two symptoms are concerned, if proper attention is given to this region. So also in later life thickening of the mucous membrane of the naso-pharynx should be reduced by suitable applications.

But the causes of these naso-pharyngeal conditions should receive their proper attention. Proper nasal respiration should be established; the habit of mouth-breathing corrected; obstructions to nasal respiration removed, to wit, deflections of the septum straightened, spurs and tumors removed, and hypertrophies reduced. By this is not meant that every structural peculiarity demands surgical interference. It is not necessary that the nose should be made anatomically perfect. This is often impossible. But that it should be put into such a state that its physiological functions may be properly performed; and that its air currents may maintain their proper directions, is evidently essential. And here it should be laid down as a law, that at the expense of the hard parts all this should be accomplished if possible, since the tissues of the soft parts are especially adapted to the preparation of the air for respiratory purposes. And it might even be called malpractice to destroy or remove a lower turbinate when the cartilage of the septum may be altered in any way to establish the proper calibre of the nostril.

If a decade ago the efficacy of this line of treatment had been extolled and so much claimed for it as has been implied, it would probably have been thought chimerical. But as nasal treatment has been so much advanced in the last ten years, it has come into the experience of every aurist that simple inflation of the ears by the Politzer air douche or even by the catheter leaves much to be desired.

The almost universal statement in the books that chronic middle ear catarrh of the so-called dry adhesive variety can only be watched, or treated so as to retard the process and perhaps keep the hearing where it is, is erroneous because, as a matter of fact, it has been abundantly proved that with a normal Eustachian tube every use of the handkerchief is more or less efficacious for inflation of the middle ear, and that the opening of the tube by every swallow is sufficient to keep up the equilibrium between the intra-tympanic air and the external atmosphere. And this leads in conclusion to the thought that the intra-nasal obstruction and abnormal contacts resulting in uncomfortable sensations of the nose, prompt the patient to use the handkerchief to excess; and when this is done in futile forceful efforts to remove fixed obstructions, the increase of pressure upon the M. T. often causes so much stretching of that delicate membrane as to preclude good results from subsequent attempts at treatment to restore the hearing. Thus frequently a patient presents himself for deafness showing a drum-head stretched in its upper posterior segment and almost invariably, also, a nose which has more or less obstruction in one or both nostrils.

ARTICLE XXXI.

SOME OF THE INDICATIONS FOR OPENING THE MEMBRANA TYMPANI.

By FREDERICK L. JACK, M.D.
OF BOSTON.

READ JUNE 8, 1897.

SOME OF THE INDICATIONS FOR OPENING THE MEMBRANA TYMPANI.

THE operation of opening the drum membrane for the evacuation of fluid is often neglected. The demand for this procedure becomes imperative, not only in most cases of acute middle ear inflammation, but also for the relief of fluid collected in the middle ear without acutely inflammatory movement. It is to the practicability and technique of the operation in these conditions that I would call attention.

Indications for Operation.—There are probably very few practitioners at the present time who do not recognize the importance of an early paracentesis in cases of acute middle ear inflammation accompanied with severe pain, marked injection, and bulging of the drum membrane. By the operation several desirable ends are at once attained. In the first place, the loss of blood, together with the evacuation of collected fluid, relieves the pressure, and thereby lessens, if not stops, the pain. The rapid healing of cut surfaces, as compared to that of the ragged tear generally produced by spontaneous rupture, has a decided bearing upon the subsequent improvement in hearing. I believe also that an early incision prevents the chances of mastoid complication. The ear trouble in very young children is frequently overlooked, a chance observation of aural discharge first attracting the attention. Children usually offer little in the way of objective symptoms; they seldom place

the hand over the affected ear, or in any way direct attention to the seat of trouble, whereas the general reflex nervous disorders, caused by the auditory disturbance, cover a wide range of symptoms, from slight twitching to a condition practically of opisthotonos, and to marked retraction of the legs, like that seen in acute abdominal affections.

The fact that more pronounced nervous symptoms result from middle ear inflammation in young children than in adults is chiefly due to anatomical conditions. In the attic, or upper wall of the tympanic cavity, is found a suture (sutura petrosa-squamosa), the connective tissue covering of which has an intimate relation with the dura mater. This suture in adults is closed by bone, often very thin bone, which retards or prevents the extension of the middle ear trouble to the dura mater or brain. An examination of the ears in infants and young children will often make clear the diagnosis, and rapid disappearance of alarming nervous symptoms will follow an early free opening of the bulging and inflamed membrana tympani.

There is another condition in which an opening in the drum membrane is of great service, and one the importance of which is less frequently recognized than that we have just briefly considered. I refer to the collection of fluid, either serous or mucous, in the tympanic cavity, following an acute catarrhal inflammation of the nose and throat. The symptoms naturally arising include impairment of hearing, a feeling of pressure or fullness, autophonia, tinnitus aurium, and possibly vertigo. The onset is often very sudden, and frequently follows too vigorous attempt at clearing the nose by blowing. The drum membrane upon inspection is found depressed from closure of the Eustachian tube, but there is seldom any considerable injection of blood vessels. The color of the drum varies with the relative thickness of the membrane and the nature of the fluid, serous exudation producing a straw color, mucous a dark

grey. Often the level of the fluid is indicated by a dark line. In many cases, however, due to pathological changes in the membrana tympani previous to the attack, it is impossible to see the fluid. We then rely somewhat on the history and upon hearing râles by means of the autoscope after inflation of the middle ear.

I am fully aware that many of these cases improve under other treatment, but I am equally certain that many cases of progressive catarrhal deafness are made permanently worse by neglecting to free the middle ear of its fluid contents. I make this statement advisedly, and with considerable experience in the treatment of these cases, both in the usual way, and by incision through the drum membrane. I have yet to meet a case in which complete evacuation of the fluid through an opening in the drum proved other than most satisfactory. On the contrary, it is not an uncommon experience for cases with undoubted history of fluid in the middle ear to present themselves for treatment after the usual means have been employed, with membranes collapsed held more or less firmly in place by adhesive bands. The operation is not difficult, provided the field is properly illuminated; it is only slightly uncomfortable, and the opening usually heals in twenty-four hours.

Technique of Operation. — The auditory canal and drum are first rendered aseptic by instillations of a one to five thousand corrosive sublimate solution; after drying with absorbent cotton a few drops of a 4% cocaine solution are applied to the drum by means of the cotton holder. The point of election is in the posterior lower quadrant. A very small incision is quickly made by a quick thrust of a sharp triangular knife, the fluid being forced out by inflation. The ease and rapidity of evacuation depend upon the nature of the fluid, thick mucus often requiring the use of small forceps, after presenting at the opening; serous fluid, on the other hand, escapes into the auditory canal,

and is removed by means of absorbent cotton. Several inflations of the middle ear, by means of the catheter or Politzer bag, are usually necessary to completely evacuate the middle ear. A small plug of cotton is placed in the meatus for twenty-four hours, then removed, and subsequent treatment is directed to the naso-pharynx and Eustachian tube. The relief afforded by paracentesis is immediate, and, with appropriate treatment, the danger of refilling slight.

Early paracentesis, under the two conditions I have indicated, will often avert alarming symptoms, and prevent serious results, not only as regards the hearing but even the life of the patient.

The suggestions offered in this brief communication are based not simply upon theoretical considerations but upon practical experience, and I am convinced that the importance of the subject has not been and cannot be over-estimated.

ARTICLE XXXII.

AURAL COMPLICATIONS OF TYPHOID FEVER.

By EDGAR M. HOLMES, M.D.
OF BOSTON.

READ, BY INVITATION, JUNE 8, 1897.

AURAL COMPLICATIONS OF TYPHOID FEVER.

THAT various ear lesions are comparatively common and often serious complications, not only in the eruptive diseases but also in typhoid fever, is a fairly well recognized fact among practitioners in general; a careful analysis, however, of the aural complications of these febrile diseases has been made by a few observers only.

In order to ascertain the frequency, the various pathological conditions and the final results, with or without treatment, of the various aural complications of typhoid fever, while aural house officer to the Boston City Hospital, in the service of Drs. J. Orne Green and George A. Leland, I examined the ears of two hundred and thirty-four typhoid fever patients. None of this number were in any way selected, and only those too sick to undergo an examination or give correct answers were omitted.

Each case was given the following examination: a record was made of the conditions found in the nose, throat, external auditory canal and membrana tympani. At every examination the temperature, as well as the mental condition of the patient, was taken and recorded for the influence they might have upon the aural conditions; and the majority of the cases were examined every second day while they remained in the hospital. I have also been fortunate in finding fourteen of the most interesting cases and examining them at their homes since their recovery from the typhoid.

Some others, although presenting interesting features which would be of considerable value to me, I have been unable to locate as they have removed from their residence as given in the hospital records. The following hearing tests were always made: 1st, the hearing distance for the watch; 2d, the hearing distance for Politzer's accumeter; 3d, the intensity and duration as recorded by Hartmann's set of five forks, C128, C256, C512, C1024, and C2048 vibrations per second; 4th, the Rinne test (the relative intensity of air to bone conduction); 5th, Galton's whistle; and 6th, in high grades of deafness a whispered voice test was made, but this as well as some of the other tests were made somewhat difficult as they were conducted in the general wards which were at times somewhat noisy.

Of the two hundred and thirty-four cases examined eighteen, or about 7%, had otitis media acuta when first examined; in five the right, in seven the left, and in six both ears were affected. Of these twenty-four acutely inflamed middle ears, six showed bulging of the membrana tympani, with more or less pain, at the first examination, and I performed immediate paracentesis. A serous discharge followed in five instances, and one was followed by a thick stringy pus. Four of the cases with a serous discharge were immediately relieved of their distressing symptoms; in two the discharge ceased within twelve hours, one closed within forty-eight hours and one in seventy-two hours. The other case became purulent upon the second day and finally developed a mastoiditis, which subsided after free paracentesis and the application of Leiter's coil and leeches. This case, which developed mastoiditis, had been suppurative about eighteen months previously, at which time the patient was supposed to have pneumonia. This was the first time the ear had been diseased and the discharge lasted about five weeks. Two of the cases in this series had a drop in temperature from 103.5 and 102 to 99 and 98.4 respectively within

twelve hours after the paracentesis, which might suggest that the middle ear inflammation had something to do with the pyrexia. Both of these patients had been sick some time when they were admitted to the hospital. One gave a history of having been sick several weeks, and after having nearly recovered was taken suddenly worse. She had had a stuffy feeling in her ear for a day and a half before the last attack. She made a rapid recovery after getting relief from her ear trouble, her temperature never rising above 99.2 after the first twelve hours following paracentesis. The other case was that of a man who had been for some time, until two days before admission to the hospital, able to be up and about the house. He gave a history of feeling a "snap" in the left ear while blowing his nose forty-eight hours before entering the hospital. The following day there was a stuffy feeling in his ear. He felt poorly and called his attending physician, who, after finding him with a high temperature, advised his admission to the hospital. He told patient he believed he had a relapse and was liable to be sick for some time. Examination showed the left membrana to be bulging. A bleb the size of a large pin head was situated just in front of the manubrium. I incised this bleb and made an opening through the membrana in the posterior inferior quadrant. The temperature, which was 102.8, was 98.5 the following morning and did not go above 99 afterward. He was discharged well at end of six days.

I always performed paracentesis under strictly aseptic precautions, and inserted a loose antiseptic wick in all serous cases. Those cases which discharged pus were syringed with corrosive solution (one to five or six thousand) every three hours if the secretion was thick in consistency and considerable in amount. When the secretion was such as to flow fairly freely the douche was used only morning and night. These cases I always gave personal attention at

least twice a day and dressed the serous cases myself. However, four of the serous cases became purulent and I had to resort to the douche.

Of the remaining twelve cases in this series one came to paracentesis and quickly subsided, four ruptured spontaneously although there was never a longer period than twenty-four hours between examinations, showing how quickly an acute ear, which seemingly does not demand surgical interference, may become so severe as to rupture the membrana tympani. Of those which ruptured spontaneously, three discharged pus and one only discharged serum. The one which discharged serum healed in five days, one which was suppurative died of the typhoid, one healed in eleven days, and the other left the hospital with suppurative ears although they received constant care while in the hospital. The nine remaining cases in this class recovered without rupture of the membrana and present nothing of especial interest.

Twenty-one, or about 9 per cent., developed otitis media acuta while in the hospital. Eight of this number were or became purulent. Six gave either a history or showed signs of a previous middle ear suppuration. Eleven cases developed during convalescence with a rise of temperature ranging from 100 to 104.5, and as a rule without or with very little pain; only five, so far as I know, complained of the ear when questioned in particular in regard to it. I made it a point to examine the temperature charts of the typhoid fever patients every day, as I usually examined the ears of only a portion in a ward at one time. I visited each medical ward every day, and was therefore able to early detect quite a large number of acute middle ear inflammations by examining the ears whenever there was a sudden rise of temperature. The house physicians also kindly co-operated with me and were of great assistance in reporting cases of rising temperature for which they could find no apparent cause. I am at present unable to explain

why so many during convalescence, with fairly clear minds, should develop acute otitis media with slight if any pain, which is so constant a symptom in most other cases. During the great nervous and mental depression at the height of the fever it seems not at all strange that the pain should not be noticed, as other stimuli may cause only slight if any impression; but many cases during convalescence developed severe inflammation of the middle ear, and even of the mastoid without complaining of pain.

Twelve of the 21 cases in this series either showed bulging of the membrane or later developed it, and paracentesis was performed. A serous discharge followed in eight cases and a purulent discharge in four. Two of the eight serous cases afterward became purulent, three were closed within twenty-four hours, two discharged a sero-sanguineous fluid for several days, and one died from intestinal hemorrhage within six hours after paracentesis. Three cases ruptured spontaneously, although I had examined them within twenty-four hours and had found no apparent bulging.

Of the four cases which were purulent at the time of paracentesis one healed on the fifth day, one ceased to discharge by the seventh day, one continued to grow worse and developed mastoid symptoms. Schrapnell's membrane was found to bulge on the third day after the first paracentesis. A free slitting of this portion of the membrane was followed by several drops of thick stringy pus; after this opening was made I syringed the attic with a 4 per cent. boracic solution every four hours for two days. The temperature dropped and the patient was relieved, all mastoid symptoms subsiding after forty-eight hours. All signs of pus disappeared by the ninth day, and the ear gave no further trouble.

Two of the cases in this class which ruptured spontaneously discharged pus, and one a sero-sanguineous fluid.

The last became suppurative at the end of three days, but ceased to discharge at the end of eight days. There was a perforation in the posterior portion of membrana about one eighth of an inch in diameter. This opening refused to close, although various stimuli as well as aseptic paper discs were used. One of the suppurative cases was healed at the end of eleven days. The other, in which the membrana was perforated at the anterior superior quadrant, just below the anterior fold, would cease to flow for a few hours. There would then be a profuse discharge, preceded by severe pain. I wished to incise the membrana in the posterior inferior quadrant when the first attack of stoppage to flow took place, but the patient refused to have anything of a surgical nature performed. Finally, at the end of five days, after having five or six attacks of severe pain, she consented to allow me to do whatever I thought best. I therefore made a curved incision below and back of the umbo near the periphery of membrana. The original opening closed by the end of three days. A profuse discharge escaped through the incision for five days, when this ceased and the ear was apparently well at the end of nine days.

Seven patients were found to have otitis media suppurativa chronica, and five otitis media suppurativa acuta. The right was involved five times, the left three times, and both four times. Two patients with O. M. S. C., one of seven years' and one of eleven months' duration, were apparently cured of the suppurative process before leaving the hospital; one died of probable intestinal perforation, and four left the hospital with suppurative ears. Three of the cases of O. M. S. A. were apparently cured before leaving the hospital; one remained in the hospital only three days, and the fifth but a week. The patient who remained but three days I afterward treated at the Boston Dispensary. I saw her nearly every day for eight weeks without apparent improvement, when I advised re-

moval of the ossicles, as there was necrosis, and the hearing in this ear was nearly nil. This operation was followed by absolute recovery from the suppurative process. A cicatricial membrane formed and completely protected the middle ear. The hearing, which was so reduced that she could not hear the watch on contact, became five inches for the watch. Six months later the hearing was tested and found not to have changed from that of the last examination.

Twelve, or over 5 per cent., of the whole number of cases gave a history or showed signs of having had suppurations which had healed. In five of these both ears, in three the right, and in four the left ear had been affected.

Two patients had furunculosis of the external auditory canal. In one the right only was affected. In the other both were diseased. In the first case it was difficult, at once, to decide whether we had to deal with a complication of a mastoid with a diffuse external otitis or an external otitis alone. The external canal was very much swollen and filled with pus. There was considerable swelling over the mastoid which was very sore to the touch. There was also some swelling of and about the tragus. The patient complained of marked dizziness with a roaring sound in the ear. Moving the head caused pain, which was located in the neck. Pressure over this area did not cause pain. The temperature was 102.3, but this was of little help, in this case, as it had remained at about this height for over a week before there were any symptoms of ear trouble. Upon the second day a furuncle had sufficiently developed to be incised and the swelling in front of the ear was greatly increased, while that over the mastoid was not so marked. As many as a score of points developed within the next three weeks. Seven of these were opened with the knife. At the end of six weeks there were no marks of the trouble remaining. The membrane was not affected and the hearing was normal.

Eleven patients had or developed a mastoiditis marked by bulging of the posterior walls of the external auditory canal, more or less swelling of the peri-mastoid tissues and tenderness over the mastoid region with more or less pain. Quite a number of others complained of some soreness about the mastoid, but as they showed no other symptom of mastoid inflammation at any time I have not included them with the cases of mastoiditis. Three of these mastoid cases resisted all palliative treatment, free paracentesis of the membrana tympani, leeching over mastoid region, Leiter's coil, etc., and came to the operation of trephining. One case, which I shall later report more fully, was admitted as typhoid, but was found after a more careful examination to have very severe mastoid symptoms, and to have a general septicæmia from a probable thrombosis of the lateral sinus or subdural abscess. After consultation it was not thought best to give ether and operate, as it was feared he would not survive the operation. He died the same afternoon and no autopsy could be obtained. One case, which was counted among the six purulent cases which followed paracentesis, developed a mastoid inflammation which subsided by the use of the usual antiphlogistic treatment, and another resisted all palliative treatment, both ears were purulent and both mastoids affected, the right side being very œdematous. The physical condition of the patient was so reduced from the long course of the typhoid that it was not thought advisable to etherize and operate. Everything which seemed possible was done for the patient, and at the end of a week he had sufficiently rallied to undergo an operation. The right mastoid was found to be very necrotic. There was an abscess in the digastric fossa which contained about three ounces of foul pus. After the operation the patient made a slow but perfect recovery.

This acute inflammation of the mastoid usually lasted only two or three days. A number of cases were relieved

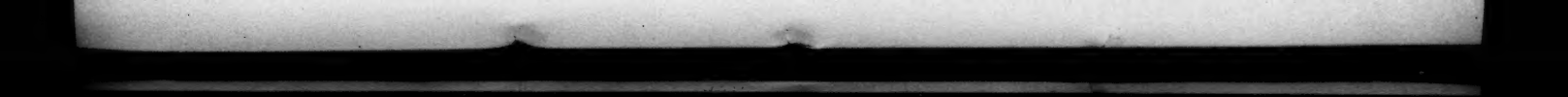
within twenty-four hours by the use of Leiter's coil, the application of leeches, and more thorough opening the membrane, when the discharge was found to be thick and to plug the original opening.

There were sixteen patients who, at some time during their disease, developed more or less marked deafness both to air and bone conduction, in whom I could find no apparent ear lesion. Some of these, which I will report individually, I examined daily and was able to trace a gradual diminution for several days, after which the hearing remained apparently stationary for a few days. There was then a gradual increase, and finally the hearing was restored to normal. In this series was one man who gradually lost both hearing and sight, although nothing abnormal in ap pearance in the ear or eye could be found. Both Dr. Wadsworth and Dr. Lancaster examined the eyes and could find no change in the eye structures. Dr. Leland examined the ears with me and could find no apparent pathological condition. There was one other case which also showed diminution of vision with that of hearing, but neither was as marked as in the case just mentioned.

This dulness of hearing must either be due to some obstruction in the external auditory canal, thickening, perforation, calcification, granulation, constricting bands or adhesions of the membrana tympani, reduced pressure in the middle ear due to closure of Eustachian tube, secretions, thickening of the lining membrane of the tympanum, decreased mobility of ossicles, granulations polypi, binding down of foot-plate of stapes, changes in the labyrinth, in auditory nerve, or loss of perception in the auditory centres within the brain. In any obstruction to the sound waves in the external auditory canal or middle ear there is diminution of sound perception by air conduction, but with obstruction in these parts alone the bone conduction is increased in intensity. In these cases the bone conduction

was decreased in about the same ratio as the air conduction. We are therefore, it seems, justified in eliminating affections of the external auditory canal, the membrana tympani and the middle ear, and have to consider affections of the labyrinth, the auditory nerve, and the central nervous system auditory centres. Were the labyrinth affected to such an extent as to produce such marked deafness, we would expect other labyrinthine symptoms as vertigo, tinnitus, nausea, and perhaps vomiting. We would hardly expect to find both sides simultaneously affected and both to the same degree so far as to the loss of hearing. Nor would we expect to find so many cases making a perfect recovery. It would seem that there was some loss of perception somewhere in the auditory centres of the brain, although the diminution of hearing was in many cases out of all proportion to the general existing mental torpor. The two cases which developed a loss of vision simultaneously with that of deafness, in whom no pathological lesion could be found, would also suggest a central origin. As every case which I examined regained normal hearing after a longer or shorter period, ranging from five days to six weeks, and as I have not been able to find any case reported where permanent deafness resulted after "typhoid deafness" of this character, it is of little importance from a practical standpoint just what portion of the auditory apparatus is affected. It is, however, important in all these cases, to eliminate middle ear inflammations which if present should receive appropriate treatment.

I will now report a few cases individually, as I take them from my notes, to more fully illustrate the classes concerning which I have already given a general outline. As is seen, I have simply divided the acute inflammations into four general classes, those which were mild, with only slight if any secretion, those in which the middle ear was distended with secretion, and were relieved by paracente-



sis, those which ruptured spontaneously, the two latter classes being sub-divided into those which discharged serum, those which discharged pus and those which were complicated by an extension of the inflammation into the mastoid cells, producing sufficiently marked signs and symptoms to make a diagnosis possible.

I. L. H. Ward H, bed 9. A well developed male of 20 years, driver of a grocery team. Has been sick three weeks; had mumps when a boy, no other sickness; never had ear trouble until yesterday. The left ear began to feel very full then, and there was an itching in the external canal.

Examination shows temperature of 102.3, pulse 88. Is mentally clear. Patient is lying on right side and breathing through mouth. Nose; right nares, inferior turbinate swollen; it entirely obstructs the air passage. Left nares clear save for a slight spur two-thirds way back on septum. There is considerable thick tenacious secretion about middle turbinate and on floor of this side. The lower turbinate is fairly clear. Naso-pharnyx: marked congestion with considerable thick mucous. Pharynx: a glassy red color and very dry. Ears: the right is apparently perfectly normal. The left membrane is much injected about manubrium. The whole membrane being of a pinkish color and very much indrawn. Hearing:

W. $\begin{matrix} R\ 16 \\ L\ 3 \end{matrix}$ Rinne $\begin{matrix} R_b^a\ \frac{21\ 26\ 34\ 29\ 7}{16} \\ C\ C^1\ C^2\ C^3\ C^4 \\ L_b^a\ \frac{14\ 17\ 20\ 21\ 6}{16} \end{matrix}$ G.W. $\begin{matrix} R\ 1.4. \\ L\ 1.2. \end{matrix}$ Web. R<L

Treatment: Cleansed nose and naso-pharynx very thoroughly with Dobell's solution, and painted naso-pharynx, about tubes, with a solution of antipyrine. Patient says the full feeling is much relieved. There is, however, no apparent change in the appearance of the membrana.

Nov. 9th. There has been no change since yesterday, only the hearing in left side has improved. Can hear watch

five inches, and the Rinne is $\frac{a14}{b5}$ C^2. The same treatment is continued. $\frac{a3}{b8}$

Nov. 10th. No change since yesterday.

Nov. 11th. To-day, as ear seemed to be as much indrawn as at first examination, after carefully cleansing nose and throat with Dobell's solution followed by a solution of boracic acid, I inflated the middle ear by means of the catheter. Patient was immediately relieved of the ringing noise which has caused considerable annoyance for the last few days. The hearing, after inflation, was thirteen inches for the watch and for Rinne $\frac{a28}{b14}$ C^2.

Nov. 12th. No ear trouble since yesterday. The ear, in appearance, is the same as the other. Hearing practically the same as yesterday.

Nov. 17th. Ears normal. Naso-pharynx much improved. Hearing is improved in both ears.

Watch R 23 L 20 Rinne R^a_b $\frac{27\ 30\ 36\ 31\ 7}{15}$ C C^1 C^2 C^3 C^4 L^a_b $\frac{44\ 26\ 29\ 28\ 4}{16}$ Webber, R=L

Nov. 24th. The last three examinations have shown practically the same conditions as that of Nov. 17th.

Dec. 23d. Nothing else developed while patient was in hospital.

II. C. P., twenty-four years old, was admitted to bed 18, ward 3, August 23, 1894. He had been ailing about one week. Had children's diseases, but remembered no ear trouble.

Examination August 25th. Temperature 101.6. Pulse 92. Seems mentally clear. Nose: save for a slight deflection of septum to the right, both sides are practically normal. Naso-pharynx: could not get clear view of with mirror, as I could not get patient to drop soft palate. Pharynx somewhat congested. Ears: both membranæ, except a slight thickening, are normal. Hearing:

Watch $\begin{matrix} \text{R } 31 \\ \text{L } 36 \end{matrix}$ Rinne $\begin{matrix} R_b^a \dfrac{26\ 31\ 34\ 27\ 7}{16} \\ \text{C C}^1\ \text{C}^2\ \text{C}^3\ \text{C}^4 \\ L_b^a \dfrac{28\ 30\ 31\ 28\ 6}{15} \end{matrix}$ Webber R=L

Galton's whistle 1.5 both.

Aug. 27th. No change.

Aug. 29th. Nose slightly congested. No other change.

Sept. 1, 3, 5, 8, 10, 12 and 15. No change.

Sept. 17th. Complains of stuffing of nose. Both turbinates are congested. Gave Dobell's solution to sniff up nose from a saturated pledget of absorbent cotton. Both membranæ are indrawn and injected. There has been no pain, but the hearing is reduced for the watch to nine inches for right, and six inches for left ear. Rinne $\begin{matrix} R_b^{a\,\frac{18}{18}} \\ C^3 \\ L_b^{a\,\frac{21}{17}} \end{matrix}$.

Sept. 20th. Can see very little change since yesterday.

Sept. 21st. Cannot hear watch. Both membranæ are very much injected but there is no bulging. There is no pain.

Sept. 22d. There is injection of the membranæ. No other change.

Sept. 24th. The hearing is somewhat improved. No change of membrane.

Sept. 26th. The hearing is nearly equal to that of first examination. The membranæ are now only slightly injected. The nose and throat are much improved. The Dobell's solution is continued.

Sept. 30th. Both ears have apparently recovered their normal condition. The hearing is:

Watch $\begin{matrix} \text{R } 34 \\ \text{L } 39 \end{matrix}$ Rinne $\begin{matrix} R_b^a \dfrac{28\ 30\ 35\ 27\ 7}{16} \\ \text{C C}^1\ \text{C}^2\ \text{C}^3\ \text{C}^4 \\ L_b^a \dfrac{29\ 32\ 31\ 27\ 7}{15} \end{matrix}$ Webber R=L

III. T. C., an emaciated man of twenty-five years, was admitted three days ago to ward T, bed 4. Has been sick

about four weeks. Began to have some pain in throat to-day. Says he has been hard of hearing for the last day or two.

Examination Sept. 21st, 1894. Temperature 103. Pulse 94. Mind clear. Nose: both sides congested and both nares contain considerable secretion which has formed crusts anteriorly. Patient is breathing through mouth. Naso-pharynx and pharynx both severely congested. Ears: right, normal; left, whole membrane is of a dark red color and is bulging. Hearing:

Watch R 18 L 1 Rinne R^a_b 21 24 23 28 6 (12) C C^1 C^2 C^3 C^4 L^a_b 5 8 11 4 2 (18) Webber R<L

I performed paracentesis, which was followed by a serous discharge. Inserted a corrosive wick. Three hours later changed wick, which was soaked with secretion.

Sept. 22d. Changed wick every three hours to-day. There is a profuse discharge. The temperature has dropped to 98.8.

Sept. 23d. There is no discharge to-day, and paracentesis opening is apparently closed. Powdered with boracic acid and placed corrosive wick in meatus. The temperature is 99.

Sept. 25th. The membrane is still somewhat injected, but there is no discharge. The hearing for watch is ten inches in left ear. Rinne for $C^2 \frac{a}{b} \frac{12}{12}$.

Sept. 27th. Nothing save a reddish line at position of incision remains to show that there has been an inflammation in ear.

Sept. 30th. Patient was to-day discharged from the hospital. The hearing has gradually improved, and for to-day was:

Watch R 26 L 28 Rinne R^a_b 26 31 33 27 6 (14) C C^1 C^2 C^3 C^4 L^a_b 27 36 35 31 7 (15) Webber R=L

IV. P. McD., well developed male twenty-one years old. Past history good. Has been sick about two weeks. Admitted to ward K, 21, yesterday. There has never been any ear trouble.

Oct. 25th, 1894. Examination: nose and naso-pharynx practically normal. Ears both normal. Temperature 99.6. Hearing:

W. R 33 / L 36 Rinne R_b^a $\frac{24\ 27\ 28\ 23\ 6}{12}$ C C^1 C^2 C^3 C^4 L_b^a $\frac{21\ 26\ 29\ 24\ 5}{13}$ G.W. R 2.1 / L 1.8 Web. R=L

Oct. 27th. No change.

Oct. 29th. Nose is somewhat inflamed. Gave Dobell's solution.

Oct. 31st. Nose is much better. Ears same as at first examination.

Nov. 2d. No apparent change.

Nov. 4, 6 and 9. No change.

Nov. 11th. To-day there is a sudden rise of temperature to 103.2. Patient complains of stuffy feeling in right ear. The hearing for watch is reduced to three inches in this ear. Upon examination the membrana is found very much inflamed and bulging. Paracentesis was followed by a few drops of pus. I placed a corrosive wick, but three hours later the discharge was so thick that I substituted the douche every three hours.

Nov. 12th. The discharge is very thick and profuse and hearing is only one inch for watch. The temperature has fallen to 99.6, which is about the same temperature as that before the ear trouble began.

Nov. 13th. No apparent change since yesterday.

Nov. 14th. The discharge is much less than it was, and is not so thick. Ordered the douche night and morning.

Nov. 15 and 16. Slight, if any change.

Nov. 17th. The discharge is now slight, and the douches are discontinued. I thoroughly cleansed ear and slightly powdered with aristol and boracic acid.

Nov. 18th. There is still a slight discharge. The external canal being simply moist. Same treatment as yesterday.

Nov. 19th. The ear was perfectly dry this morning, but hearing is only two inches for watch and for fork.

Rinne $\begin{matrix} a21 \\ C512. \\ b19 \end{matrix}$

Nov. 25th. The last two examinations have been the same as the last report. To-day I inflated ear with catheter and obtained thirteen inches for watch. Rinne $\frac{a21}{b16}$ for C^2.

Nov. 28th. The right membrana is found to be indrawn and I again inflated with very little improvement in hearing since last note.

Dec. 1st. Hearing to-day was practically that of the first examination. The membrana was normal in appearance. The patient was discharged from the hospital to-day, having recovered from the typhoid.

V. M. L., a young unmarried woman of twenty-five years, with a large frame, but emaciated. Says she has not eaten for four weeks save a little beef tea and gruel. Was admitted to hospital six days ago, but through some oversight I saw her for the first time to-day.

Sept. 27th. Examination. Nose: right naris considerably obstructed by a large spur. The middle turbinate is more spongy than normal. The left side of septum is indented at position opposite the spur in right side. The inferior turbinate is hypertrophied. There is also a hypertrophy of the naso-pharynx. The tonsils are large and follicular. Ears: both membranæ present about the same appearance, viz.: prominent posterior fold. Prominent short process of malleus, and a very narrow light reflex. No acute process is to be made out. Hearing:

W. $\begin{matrix} \text{R } 14 \\ \text{L } 5 \end{matrix}$ Rinne $\begin{matrix} R_b^a \frac{17\ 20\ 24\ 19\ 5}{16} \\ \text{C } C^1\ C^2\ C^3\ C^4 \\ L_b^a \frac{16\ 17\ 23\ 18\ 6}{16} \end{matrix}$ G.W. $\begin{matrix} \text{R } 1.4 \\ \text{L } 1.2 \end{matrix}$ Web. R<L

Sept. 29, Oct. 1, 3, 5, 7 and 10. No change.

Oct. 12th. To-day right ear is injected. There is no pain or any other ear symptom.

Oct. 13th. Was surprised to find the right ear discharging a bloody serum to-day, as it had only been thirteen hours since the last examination when there was no bulging and only slight inflammation apparently. The patient has had no pain, and has complained of no ear symptoms. The hearing is 0 for watch in right ear. Not changed in left.

Oct. 14th. The discharge is very profuse but remains serous in nature. Corrosive wicks are inserted every three hours.

Oct. 15th. Until to-day I have been unable to see the perforation. It is now easily made out in anterior quadrant, just in front of umbo. It is about the size of a medium pin head. The ear is discharging profusely. Patient complains of pain in occipital region, but I can find no cause for it.

Oct. 16th. There is no pain. The discharge is about the same.

Oct. 17, 18, 19 and 20. No change.

Oct. 21st. The discharge is less to-day. There is no change in the hearing either for the watch or the tuning forks.

Oct. 22d. There is fully as much discharge to-day as there was at first. There are no serious symptons.

Oct. 24th. Since yesterday there has been only a slight discharge. Was able to hear the watch to-day, at a distance of one inch, in the right ear. The left ear has maintained normal hearing throughout.

Oct. 26th. To-day external canal is dry. The perforation remains about the same size. The hearing is:

Watch $\begin{matrix} \text{R } 3 \\ \text{L } 7 \end{matrix}$ Rinne $\begin{matrix} \text{R}^a_b \dfrac{14\ 13\ 19\ 15\ 5}{14} \\ \text{C}\ \text{C}^1\ \text{C}^2\ \text{C}^3\ \text{C}^4 \\ \text{L}^a_b \dfrac{16\ 18\ 23\ 17\ 6}{16} \end{matrix}$

Nov. 1st. No change since last note.

Nov. 5th. The last two examinations show no marked change in appearance or hearing. The perforation is slowly granulating.

Nov. 8th. Perforation entirely closed. Hearing not changed.

Nov. 11th. To-day hearing for watch was nine inches before inflation and fourteen inches after. Middle C fork before $\frac{a}{b}\frac{28}{18}$, after $\frac{27}{15}$.

Nov. 15th. Patient was discharged from hospital to-day. There had been very little change in the last three days.

VI. M. R., laboring man, forty-three years old, was admitted two days ago to ward T, bed 6. Has been sick for a few days, and has not been feeling well for two weeks. He has a temperature of 103.7 and the cold sponge baths affect it for a short time only.

Examination August 27th, 1894. Nose: practically normal. Naso-pharynx: normal. Ears: both membranæ apparently normal. Was too sick to make a full hearing test. I simply tested for the watch and this showed about twelve inches for both ears.

Aug. 29th. No change.

Sept. 1st. The hearing is only four inches for the watch in both ears. I could find no other change. The temperature was 101.4°. The mind seemed as clear as at first.

Sept. 3, 5 and 7. Practically no change in patient.

Sept. 9th. Temperature still remains high, but can hear watch at distance of eight inches.

Sept. 11th. There is considerable improvement in general condition and I made a thorough examination to-day. The nose and throat are considerably congested. Patient breathes mostly through mouth. There is no change in appearance of ears. Hearing:

W. R 11 / L 8 Rinne $R^a_b \frac{23\ 22\ 23\ 21\ 6}{8}$ C C^1 C^2 C^3 C^4 $L^a_b \frac{21\ 24\ 25\ 19\ 5}{10}$ G.W. R 2.3 / L 2.3 Web. R=L

Sept. 13th. No material change.

Sept. 15th. For last day there has been a heavy feeling in right ear. No real pain. There is a beating noise. The membrana is indrawn and the manubrial plexus is injected.

Sept. 16th. The ear snapped this morning like the report of a pistol. This was immediately followed by a discharge of "bloody matter" from the external canal. I found canal of right side filled with pus four hours after rupture. The rupture is an irregular one, just back of umbo. Syringed every three hours with solution of corrosive (1 to 6000).

Sept. 17th. The discharge is very profuse. The perforation seems much larger than it did yesterday. Same treatment.

Sept. 18, 19 and 20. No change.

Sept. 21st. The perforation is undoubtedly larger than it was three days ago. It is as large as a grain of wheat.

Sept. 22d. There is a bulging of the posterior wall of the canal and tenderness over the mastoid antrum. Applied two leeches over mastoid and ordered a Leiter's coil applied.

Sept. 24th. The mastoid inflammation has apparently subsided. The ear still discharges profusely. The discharge is very thick.

Sept. 25, 26 and 27. No change.

Sept. 28th. The discharge is slightly less in amount.

Sept. 30th. There is an increase in the amount of discharge.

Oct. 3d. The discharge is much less. The left ear has remained normal. The hearing in the right has been from one-half to one and one-half inches.

Oct. 5th. There was only slight discharge to-day, and the douche was discontinued. The perforation is much smaller.

Oct. 7th. The discharge has ceased. The hearing is:

W. $\begin{matrix} R\ 7 \\ L\ 8 \end{matrix}$ Rinne $\begin{matrix} R_b^a\ \frac{15\ 17\ 18\ 16\ 5}{10} \\ C\ C^1\ C^2\ C^3\ C^4 \\ L_b^a\ \frac{21\ 22\ 26\ 20\ 5}{10} \end{matrix}$ G.W. $\begin{matrix} R\ 1.8 \\ L\ 1.8 \end{matrix}$ Web. R>L

Inflation did not change hearing.

Oct. 10th. I again inflated ear to-day and hearing was one inch for watch.

Oct. 15th. The perforation is nearly closed. The hearing is same as last note. Patient left hospital to-day.

April 8th, 1895. Examined patient at his home and found he could hear in the poor ear five inches. The Rinne was $\begin{matrix} R_b^a\ \frac{21\ 24\ 25\ 20\ 6}{8} \\ C\ C^1\ C^2\ C^3\ C^4 \\ L_b^a\ \frac{23\ 22\ 26\ 21\ 4}{9} \end{matrix}$. No Webber. The membrana is considerably distorted by a dense cicatrix.

There are no ear symptoms.

VII. J. C., a short, muscular Italian, nineteen years old, was admitted to ward K, bed 10–2, yesterday. He is supposed to be at about the beginning of the third week of typhoid fever.

Sept. 23d, 1894. Examination. Temperature 102.8. Pulse 94. The hearing tests are very unsatisfactory, as patient answers yes to everything. Nose: normal. Naso-pharynx: normal. Pharynx: congested. Ears: both normal.

Sept. 5th. It is absolutely impossible to make a hearing test.

Sept. 8, 11, 14 and 16. No change.

Sept. 19th. The right membrana is indrawn. Cleansed nose and naso-pharynx with Dobell's solution and then painted the naso-pharynx with solution of antipyrine.

Sept. 20th. Apparently the membrana has returned to normal position.

Sept. 22d. The nose and throat are much improved.

Sept. 24 and 27. No change.

Sept. 30th. Both membrana are indrawn and the right is congested. Given the same treatment as upon the 19th.

Oct. 1st. Ears are better. Nose and throat about the same.

Oct. 3d. There is more congestion of the right ear.

Oct. 4th. The membrana of right is bulging, also posterior wall of external canal is swollen. The mastoid is sore to pressure. Paracentesis was followed by serum. Applied leeches and Leiter's coil.

Oct. 5th. Mastoid symptoms have subsided. There is no discharge from ear.

Oct. 7th. Improving.

Oct. 10th. The left ear is considerably inflamed. The patient's general condition is very poor. He has a continued high temperature.

Oct. 12th. No change.

Oct. 15th. There is again a mastoid inflammation on the right side. The membrana has ruptured and is discharging pus. The left ear is somewhat improved.

Oct. 16th. There is considerable swelling of mastoid. The leeches and cold coil seem to produce no effect. Had a temperature of 104.2 this morning. Dr. Leland saw patient with Dr. Mason and Dr. Post and they were all of the opinion that patient would not survive an operation. I freely incised the membrana and substituted hot water bag for ice coil.

Oct. 17 and 18. Practically no change.

Oct. 20th. The general condition is better. The ear discharges profusely, and is syringed every three hours.

Oct. 22d. The left mastoid has become inflamed. Paracentesis was followed by pus. Applied Leiter's coil.

Oct. 23d. No change in right side. Left side much better.

Oct. 25th. Dr. Leland operated upon right mastoid to-day. The whole mastoid was infected. The lateral

sinus was exposed and covered with granulation tissue. The sinus contained normal blood. A sinus was followed downward and backward into the digastric fossa where an abscess cavity was found, containing foul pus. Another opening was made from below into this cavity, in order to better drain it. The wound was dresssed in the usual manner.

Nov. 1st. Patient has done nicely since operation. He feels very hungry but has only typhoid diet. Dressed wound.

Nov. 6th. Wound again dressed. It is granulating very fast.

Nov. 13th. The lower abscess cavity has closed. Was given solid food, as temperature has been normal for two weeks. Left ear entirely well.

Nov. 16th. Complained of pain in right ear to-day. I removed dressing and could find no cause for pain. The wound is fast filling in.

Nov. 23d. Is up and about ward. Has had no more pain.

Nov. 30th. The wound has entirely healed and patient was discharged well. The hearing was:

$$\text{Watch } \begin{matrix} \text{R } 4 \\ \text{L } 12 \end{matrix} \quad \text{Rinne } \begin{matrix} \text{R}_b^a \frac{21}{14} \\ \text{C}^3 \\ \text{L}_b^a \frac{26}{15} \end{matrix}$$

VIII. H. W., a well developed and nourished young man, twenty-two years old, has been sick about ten days, and at present has a temperature of 102.8. He is given frequent baths but it is impossible to keep temperature below 102.

Examination Sept. 18, 1804. Nose: the whole Schneiderian membrane is considerably congested. Naso-pharynx: membrane covered with a thick, tenacious secretion. Ears: both normal. Hearing:

W. R. 34 L. 37 Rinne $R_b^a \frac{28\ 33\ 38\ 24\ 7}{15}$ C C^1 C^2 C^3 C^4 $L_b^a \frac{25\ 31\ 34\ 26\ 7}{14}$ G.W. R 1.4 L 1.4 Web.R=L

Sept. 20th. Is very sick. Pulse is 115. Temperature 103. I simply examined the membranæ, which were normal.

Sept. 22, 24 and 26. Patient too sick to examine for hearing. Membranæ both normal.

Oct. 1st. Tested hearing to-day, for the first time since first examination, and found practically no change.

Oct. 3, 5, 7 and 10. No change.

Oct. 13th. No change in appearance, but hears watch only twenty-three inches in right and twenty-four inches in left. Rinne $R_b^a \frac{2}{1}\frac{9}{4}$ C^2 $L_b^a \frac{2}{1}\frac{8}{3}$

Oct. 15th. I can find no pathological condition, but hearing is 17 inches in both ears. Complains that for the last two days has not been able to see distinctly.

Oct. 16th. Hearing is reduced more than yesterday, hearing only seven inches for watch. Cannot see as well as yesterday. Dr. Lancaster examined the eyes with me and could find nothing abnormal.

Oct. 17th. Can hear watch only three inches. Cannot tell watch from knife when held two feet from eyes.

Oct. 18th. Cannot hear watch in either ear.

Rinne $R_b^a \frac{7\ 11\ 13\ 9\ 3}{6}$ C C^1 C^2 C^3 C^4 $L_b^a \frac{8\ 10\ 12\ 10\ 3}{5}$

Dr. Wadsworth examined eyes and could find no cause for loss of vision. Can count fingers, and that is about all.

Oct. 19th. Cannot hear watch. Can be made to understand by shouting into ear. Can only distinguish between light and darkness.

Oct. 20, 21 and 23. No apparent change in either hearing or sight.

Oct. 25th. Could hear watch about one inch in both ears. Could determine no change in vision.

Oct. 27th. Slight improvement in both ears since last note. Can count fingers with both eyes.

Watch R 3 L 3 Rinne R^a_b 10 13 15 11 4 / 7 / C C^1 C^3 C^2 C^4 L^a_b 11 13 16 12 4 / 7

Oct. 29th. Can hear

Watch R 5½ L 6 Rinne R^a_b 13 15 18 12 4 / 8 / C C^1 C^2 C^3 C^4 L^a_b 14 15 19 13 5 / 8

I have tried Galton's whistle at every examination, but the results have been very unsatisfactory, as the hearing has been so reduced that he could only hear the shrill tones.

Oct. 31st. No material change since last note.

Nov. 2d. Hears watch about ten inches in both ears. Can apparently see better than at last trial.

Nov. 4th. Could distinguish between spoon and knife held at three feet from eyes. This is the first time he has been able to distinguish objects since the loss of vision. Says he can see better every day. The hearing was:

Watch R 11 L 12 Rinne R^a_b 14 15 21 14 5 / 9 / C C^1 C^2 C^3 C^4 L^a_b 15 17 22 14 5 / 10

Nov. 8th. Hears

Watch R 14 L 14 Rinne R^a_b 15 18 23 15 5 / 10 / C C^1 C^2 C^3 C^4 L^a_b 16 19 25 16 5 / 10

Hears all conversation. Said to-day, that while he could neither see or hear, his mind seemed fairly clear to him, but he had the feeling that he was shut out from the world.

April 13th. No apparent change.

Nov. 16th. Hears watch right sixteen inches, and fifteen inches in left. Could read coarse headings of newspaper.

Nov. 22d. No change the last few days. Patient is about ward, and so seems to be getting strong and to be gaining flesh.

Nov. 27th. Hearing for watch is twenty inches in both ears.

Nov. 29th. Patient has been discharged from hospital.

March 18, 1895. Saw patient at his home, and found vision in both eyes to be $\frac{20}{15}$. Can read without any trouble. Hearing is the same as when I first examined him in the hospital.

This report shows that there were thirty-nine patients of two hundred and thirty-four who at some time during their stay in the hospital had acute inflammation of the middle ear. That nineteen were so severe as to produce bulging or membrane at first examination, or later became so, and demanded paracentesis, which was followed in fourteen cases by a serous, and in five cases by a purulent discharge; that seven ruptured spontaneously being followed five times by pus and only twice by a serous discharge; that eleven patients had mastoid inflammation, yielding to ordinary treatment in seven cases, demanding operation in three, and one dying before operation could be performed. That five patients were found to have otitis media suppurativa acuta, and that eleven developed it while they remained in the hospital. That seven had otitis media suppurativa chronica of long standing, two of which were cured by removing old granulation tissue from middle ear and cleansing with corrosive solution. That sixteen cases of deafness occurred without any apparent ear lesion, and that two of these cases also developed a gradual loss of vision. Every case of this form of deafness recovering normal hearing, and the two with visual changes recovering both hearing and sight.

The marked contrast in the course of the inflammation in those cases which ruptured the membrana, and in those

which were relieved by paracentesis, is very apparent. The average duration of discharge after paracentesis was about five days, several healing within twelve hours. Those which ruptured spontaneously not only discharged for a longer period, but left more destruction of the membrana, and were more frequently followed by mastoid complications. There was not a case where paracentesis was performed where the opening in membrana did not close.

Among those which ruptured without interference, there were two permanent perforations, although I did everything I could to prevent this result.

It is also seen that four of the fourteen serous cases became purulent, although I used the utmost care to prevent infection from the external canal. As pus followed five cases of paracentesis, I have reason to believe that those which were apparently serous were already infected through the Eustachian tube, or were later infected through this channel.

If this paper shall impress upon the minds of other physicians, as the research has upon me, the necessity of carefully watching the ears of typhoid fever patients as we now do the pulse and temperature, I believe many and grave ear complications may be interrupted and relieved.

ARTICLE XXXIII.

MEDICAL INSPECTION OF SCHOOLS.

By SAMUEL H. DURGIN, M.D.
OF BOSTON.

READ JUNE 9, 1897.

MEDICAL INSPECTION OF SCHOOLS.

THE influence of schools upon the spread of infectious diseases, and the need for the exercise of greater public care over the schools, have been much discussed within the last few years, and with nearly unanimous conclusions. I think we should all agree upon the fact that the collection of large numbers of people within small spaces, generally speaking, furnishes the most favorable opportunity for the spread of infectious diseases, but more particularly with school children whose susceptible age and familiar habits render them unusually liable to the incidence and extension of these diseases. We shall also agree that the infective agent is frequently present in our public schools and that it only remains to be shown by what means the infection is conveyed.

For the purposes of this brief paper we shall need to consider but two of the most common and dreaded infectious diseases—diphtheria and scarlet fever, and perhaps diphtheria alone would be sufficient.

It was thought from the beginning of our knowledge of diphtheria until within a few years, that it belonged in the list of what has been termed filth diseases, and with this view in mind Boards of Health followed out different lines of work for the purpose of proving or disproving the theory that this disease might be caused by any unsanitary conditions.

In 1878 the Board of Health, with which I am identified in Boston, called for reports of cases of diphtheria, and for the last nineteen years we have examined every house in which a case of diphtheria was reported, and amongst other reasons to see what connection filth and defective drainage within buildings had with the prevalence of this disease, but with such negative results as to warrant the belief that it is scarcely, if at all, more likely to occur in the poorly constructed and badly kept houses than in the best. The percentage of defects found in connection with cases of diphtheria is found to be but slightly greater than that found when examining from house to house where no disease or complaint has occurred.

In 1882 we made an investigation to ascertain what connection there might be between cases or groups of cases of diphtheria and street gullies, perforated sewer covers, sewer outfalls, proximity to tide water flats, low damp ground and high ground. Here again we found not even a suspicion of relation between cases of diphtheria and any of the suspected causes. On the other hand we are continually reminded of the unmistakable direct or indirect connections between new cases of these diseases and other infected persons or rooms and articles which have become infected. We are forced to believe that the means by which children afflicted with diphtheria may and do create foci of infection in our school buildings as well as in their homes, and the facilities by which others may take on the infection from such foci, are both natural and easy. I think we are warranted in this belief by every process of reasoning and upon the facts connected with the disease. Diphtheria is, unquestionably, an infectious disease and may be communicated directly from person to person, or indirectly through some intermediate object upon which the infective matter may have been lodged and where it may remain active for a longer or shorter time. The local manifestation of

diphtheria is nearly always in the throat, where we have the bacilli of the disease in abundance, mixed with the secretions of the throat and mouth, and in the most convenient form to be transferred to any surrounding object. This infective matter is easily scattered and attached to things by coughing, sneezing and spitting, or by the fingers which perform a continual messenger service between the month and whatever may be touched within the reach of such fingers. We have, for instance, a child suffering from diphtheria in school, not ill enough to attract special attention. He may be there for a day or two before the disease is discovered, with a mild, unrecognized case, or he may be there for a much longer time, in a condition for spreading the disease. During this time he may attach the infective matter to the desk, chair, books, slate, slate-pencil, lead-pencil, pen-holder, sponge, drinking cup, door-knob, door, window sill, banister, wainscotting, or to anything else which he may handle or touch after using his fingers about the mouth. The fact that these things may become infected with diphtheria in this way has been conclusively shown in the laboratory by Professor Ernst.

In kindergarten schools the danger of spreading the disease by a single case is much greater, both by direct and indirect infection, because these children by virtue of the different processes of teaching are brought into much closer contact with each other, and they use a large number of objects in common which are very liable to become infected. One unrecognized case under such circumstances may give rise to a dozen more, and without our being able to trace one of them to its particular source.

The following account of a kindergarten teacher may be of interest at this point:

"Regarding the contact of children with each other in kindergarten and the interchangeable use of material, it is

as follows: The chairs for seating the children are small portable ones. These are carried from one place to another as the classes need them; no one chair is allotted to any particular child, all are used in common. The tables at which the children sit are long enough for four or five children to sit at each. It is impossible to arrange so that each child may have the same chair or the same place at the table regularly. The material used is such that it is almost impossible to let one child use any portion of it solely as his. We have but two dozen worsted balls with which to teach color, form and direction; and we have seventy children to use the ball. It is the same with everything else. The blocks used are handled by two or three classes during the same day. The iron rings, wooden sticks, wooden planes, paste-board tablets, wooden beads, weaving needles and worsted needles are all used in common. The napkins used at lunch time are washed once a week and taken out before then if really soiled, otherwise they are folded and returned to the drawer ready for the next day. The picture books are enjoyed by all and the dolls are used at every recess. In playing the games the children stand holding hands on the ring, and when there is good attendance they are crowded.

Many of the games bring them very close together, for instance:

In playing the 'Birds Nest' the mother bird chooses six or more children who kneel upon the floor in a semicircle, she twines their arms about each other to imitate weaving the nest. She then chooses three children who are put close together, necessarily, in the nest and then the game proceeds. This is a typical bird game and is very pretty, but in time of epidemic of throat diseases we do not like to play it in our kindergarten as it brings the heads so near each other. There are other games, of course, which do not need such close proximity as the one described, but all the games are for two or more children to take part in and they are generally in contact in some way if only holding hands."

Numerous instances have come under our observation where a child has been found in school suffering from an

infectious disease by the medical inspector of schools, and sent home; this case has been followed in due time by other cases in children whose only discoverable exposure was that which occurred in the school room. Fresh evidence of such exposure and of its effects has been brought to my attention within a few weeks occurring in the service of Dr. Arnold, one of our school inspectors. An epidemic of diphtheria occurred in a primary school in which there were forty pupils, fourteen of whom were attacked with diphtheria within a period of eighteen days, all from one room. Of the fourteen cases seven were discovered by the school inspector and three of these only by cultures. All suspicious cases were dismissed from school May 5th, and recommended to the care of their family physicians. The next morning every pupil was examined and many cultures were taken. The class was then dismissed from Thursday to the following Monday, the room disinfected and cleaned up. For ten days after their return the throat of every pupil was examined by the medical inspector when they first assembled in the morning, and no pupil who had been absent with any suspicious symptoms was allowed to return until it was proved by a negative culture that there could be no danger. As a result of these measures not a single case of diphtheria resulted beyond those known to have been infected at the time the epidemic was discovered. A similar experience with scarlet fever occurred in the service of the same school inspector within two weeks, in which eleven cases resulted from the presence in school of one pupil whose illness had been attributed to German measles.

The following tables give the number of cases of diphtheria and scarlet fever reported in Boston, by months for nineteen years and twenty years respectively, and show that when the schools are in session the number of cases is much greater than during vacation time.

Cases of diphtheria reported each month for nineteen years:

Years.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1878	241	178	135	102	58	114	65	44	87	106	98	125
1879	155	111	82	108	87	111	53	37	53	100	132	146
1880	167	141	112	101	143	126	100	74	105	150	238	258
1881	179	163	190	140	142	143	108	85	103	162	135	130
1882	136	117	99	92	103	111	56	56	54	119	188	244
1883	170	132	100	98	140	94	64	72	88	126	150	175
1884	130	90	87	81	111	95	50	61	77	130	137	163
1885	164	117	108	109	101	108	85	54	64	123	119	111
1886	122	104	110	66	73	94	75	78	85	130	111	140
1887	128	93	96	101	75	68	53	40	53	112	100	130
1888	112	80	105	107	142	110	97	92	95	143	156	172
1889	179	150	193	205	190	165	93	99	99	137	130	174
1890	203	189	156	164	144	114	73	69	75	96	75	117
1891	80	71	59	71	81	49	31	36	40	78	180	127
1892	102	108	114	135	107	77	76	78	79	144	185	175
1893	152	114	116	70	86	111	88	102	89	194	160	183
1894	195	128	185	139	187	167	138	154	249	450	558	469
1895	343	296	205	185	225	328	268	278	345	415	635	564
1896	381	403	302	304	346	352	300	256	296	461	498	466
Total,	3339	2794	2554	2378	2541	2537	1873	1765	2136	3376	3913	4059

Cases of scarlet fever reported each month for the last twenty years:

Years.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1877	262	227	181	176	117	67	28	25	16	61	70	104
1878	161	99	73	48	35	47	25	36	43	67	94	119
1879	131	108	190	93	82	32	27	47	55	57	65	63
1880	60	36	47	29	32	35	19	10	29	44	89	67
1881	58	28	52	51	41	44	17	11	17	16	19	29
1882	65	41	49	36	70	61	26	41	37	48	102	104
1883	123	82	83	104	101	103	65	89	85	214	168	195
1884	209	186	197	239	215	173	214	209	175	242	224	242
1885	232	131	182	159	160	135	85	56	87	153	148	137
1886	155	126	144	151	115	99	56	52	43	58	82	68
1887	97	76	101	102	98	62	29	51	142	207	320	268
1888	146	119	100	75	70	20	19	11	16	52	29	40
1889	48	29	77	59	53	34	15	15	17	32	36	49
1890	98	103	105	122	118	74	72	30	20	30	40	112
1891	109	95	108	151	159	97	49	40	56	67	136	260
1892	290	291	447	335	370	217	124	86	100	183	226	269
1893	282	190	228	245	203	144	144	140	179	304	283	238
1894	214	169	168	199	266	205	109	135	125	182	192	278
1895	231	174	184	139	137	123	94	82	91	127	120	113
1896	136	99	104	108	77	113	72	42	53	81	157	176
Total,	3107	2409	2820	2621	2519	1885	1289	1208	1386	2228	2600	2931

It will be seen by an examination of the table for diphtheria that the average number of cases reported for each of the eight school months is 2,772, and for the four months of little or no school it is 2,077. In the table for scarlet fever it will be found that the average number of cases reported for each of the eight school months is 2,779, and for the four summer months it is but 1,191.

We do not claim that the closing of the schools is the only cause for the largely diminished amount of scarlet fever and diphtheria, but we believe that it is one of the important factors. Owing to the evident spread of scarlet fever and diphtheria in the schools, we recommended, in 1882, that the school-houses be thoroughly disinfected once in two weeks. This proposition was rejected, however, on the grounds that it would cost from $5,000 to $6,000, would be a hardship to the janitors, and that it might not effectually prevent the spread of the disease. From time to time since that date we have recommended to the School Board the need of frequently cleaning and disinfecting such parts of the interior of school buildings as might become infected, and that the use of many objects in common use among the children and which might easily become sources of infection, be discontinued. A few of these recommendations have been adopted. In 1890 the Board of Health proposed to furnish the schools with daily medical inspection with a view to discovering the earliest symptoms of infectious diseases among the children, by examining all cases of children sick or complaining from any cause in the schools, and giving to the teachers such professional advice as is constantly needed for the disposition of such children. After four years of unsuccessful efforts the Board succeeded, under the influence of a severe epidemic of diphtheria, and began the work November 1st, 1894.

The Board of Health divided the city into fifty districts,

giving an average of about four school-houses and fourteen hundred pupils to each district. No difficulty was experienced in finding well qualified and discreet physicians who would undertake the duties prescribed; and the Board selected and appointed one physician for each district with a salary of $200 a year. His duty is to make a visit to each master's school daily, soon after the beginning of the morning session. The master receives from each of the teachers in his district early reports as to the appearance of illness in any pupil in his charge. These reports are given to the visiting physician, who at once examines the reported children and makes a record of his diagnosis and action in books furnished by the Board of Health for this purpose and kept in the custody of the master. If the visiting physician finds the child too ill, from any cause, to remain in school, he advises the teacher to send the child home for the observation and care of its parents and family physician. If the illness is from a contagious disease the child is ordered home and the case reported to the Board of Health. The disposition of the sick child while at home, and the proper isolation in cases where contagious diseases develop in such children, as well as giving them a warrant for returning to school, depends principally upon the report of the school inspector.

In the examination of the children in school every facility is extended to the doctor by the teachers, and he in turn reaches a satisfactory conclusion with the least possible delay or annoyance to any one. There being frequent need for looking into the children's throats, we provided the inspectors with something for a tongue depressor which could be used once and destroyed, and thus get rid of the danger of communicating any disease from one pupil to another, and avoid unfavorable criticism on that score. I have some of them here to show you. These little pieces of clean pine are made for us at a cost of one-tenth of a cent each.

They are without objection in use or appearance, and will burn as easily as a match, which is the intended destiny of each after being used once. The thermometer is rarely a necessity in these examinations, and when used is treated with due care.

The school inspectors do not give professional treatment in any case. They merely point out the need of professional treatment where the need exists. The treatment itself must be received from the family physician, or in the hospitals, or in the dispensaries, and great care is necessary to avoid giving offence to physicians and their families.

It should be remembered that the Boards of Health of this State are authorized and required by statute law, to take charge of any case of contagious or infectious disease which may be dangerous to the public health; and while it is preferred that many cases should remain at home and be cared for by the family and the family physician, their isolation at home must be satisfactory to the Board of Health, and so certified by a medical agent of the Board. So also in the discharge of such patients from isolation, the evidence of their freedom from the disease, and the safety of their return to school or to the public, must be satisfactory to the Board of Health and come from its medical agent. For this duty the same medical inspectors are serving as agents of the Board of Health in the control of infectious diseases which are treated at home. We send to each of the school inspectors every morning a bulletin of the cases of diphtheria and scarlet fever which have been reported during the previous twenty-four hours. Each medical officer selects the cases reported in his district, visits them to see if they are properly isolated, leaves a card for the attending physician informing him of the official visit, and reports his approval or disapproval of the patient's isolation at once to the Board of Health. If the patient is properly isolated the inspector places a card on the door of the room to indi-

cate the official designation of the room for the isolation of the patient. If the case is not properly isolated, and it cannot be commanded at home, he reports the fact to the Board of Health, and such patient is taken to the hospital. He makes another visit to the patient on the question of discharge from isolation, and again reports to the Board of Health. If it is a case of diphtheria a negative report from the laboratory to the Board of Health is necessary, and if it is a case of scarlet fever desquamation must have ceased, and the fact certified by the agent before such patient can lawfully be released from isolation. The agent of the Board is thus held responsible for the proper isolation of the patient at home, for recommending the patient's removal to the hospital when necessary, and for the patient's release from isolation. In other words, the Board of Health is provided with trustworthy information upon which it can act for the best protection of the schools and the public against the spread of infectious diseases.

This corps of inspectors has become an organized association, which meets once in two months, to discuss the manifold medical questions which arise in the performance of their duties.

The whole number of children examined in 1896, and found to be ill, was 8,964. The diseases of which the children were suffering were classified as follows:

Specific Infectious Diseases,	267
Oral and Respiratory Diseases,	3,934
Ear Diseases,	66
Eye Diseases,	382
Skin Diseases,	628
Miscellaneous Diseases,	3,687

Those who were found to be suffering from infectious diseases were, as a rule, unaware of the fact, owing to the early stage of the disease or to the mildness of the attack. Occasionally one is found who has been prematurely re-

leased from care. All, however, were in a condition to spread the disease from which they were suffering.

There are about 85,000 pupils and over 1,500 teachers in the public schools, and about 13,000 pupils in the parochial schools of Boston which furnishes a wide field and the best opportunity for the exercise of professional observation and sanitary precautions against the diseases of childhood incident to school attendance. This work has now been in successful operation in Boston for two years and seven months, has constantly grown in favor in the medical profession, among the school teachers and in the community at large. There is every reason to suppose that under the influence of this daily medical attention every teacher will become more interested and expert in the outlook for and detection of any existing illness amongst the children under his or her care. Every parent may feel that his child is less exposed to disease while in school, and less likely to be ill without immediate attention from teacher or physician than was formerly the case.

This is the first work of its kind performed in this country, and, so far as I am able to learn, in the world. The nearest approach to it is done in Brussels where, under the control of the Bureau of Hygiene, school doctors are employed, and to whom the pupils are sent when suspected of being ill with infectious diseases. Our work has been recently copied in many places in this country, including the city of New York, where it has been employed for the last three months with complete satisfaction.

I am satisfied that it would be hard to find a field for medical inspection and supervision which presents equal facilities for the early detection of diseases, or which offers more satisfactory results.

ARTICLE XXXIV.

THE ROENTGEN RAYS IN THORACIC DISEASES.

By FRANCIS H. WILLIAMS, M.D.
OF BOSTON.

READ JUNE 9, 1897.

THE ROENTGEN RAYS IN THORACIC DISEASES.

It gives me pleasure to bring before this Society a subject which is of so much importance to practitioners as the clinical uses of the X-rays in certain cases. During the past year* I have examined by means of the rays more than five hundred patients — about one hundred of which were surgical cases — at the Boston City Hospital and at my office.† The majority of the four hundred medical cases were suffering from some thoracic disease; certain of these patients — those ill with pneumonia for instance — have been examined a number of times, as I wished to watch the progress of the disease and see the conditions presented in its different stages.

No harmful effects have been received in any way by these patients, and there need not be the slightest anxiety on the part of any one if proper precautions are taken.

*I have reported the results of my study at medical meetings, or by published articles, as follows:

Meeting of the Suffolk District Medical Society, April, 1896. Meeting and Proceedings of the Association of American Physicians, 1896. "Notes on X-rays in Medicine."

Boston Medical and Surgical Journal, October 1, 1896. "A Method for more fully Determining the Outline of the Heart by Means of the Fluoroscope, together with other Uses of this Instrument in Medicine."

Meetings of the Boston Society for Medical Improvement, and of The Medical Society of the Boston City Hospital, October and November, 1896.

Medical and Surgical Reports of the Boston City Hospital, January 1, 1897, pp. 134–190. "A Study of the Adaptation of the X-rays to Medical Practice."

†In making these examinations I have used a Wimshurst machine and an induction coil, but principally the former, both of which were designed by Messrs. C. L. Norton and R. R. Lawrence, of the Massachusetts Institute of Technology.

I have seen, however, several persons who have suffered a more or less severe inflammation of the skin, the nails also being sometimes involved, but they were all individuals whose occupation brought their hands into close proximity to the Crookes tube, or who, for purposes of testing its possibilities for harm, had exposed a part of the body to its action at a distance of a few inches for a considerable period; but there are simple ways of obviating these effects.

Before taking up the uses of the X-rays in diseases of the thorax, let me call your attention to one or two points on which their usefulness depends.

The varying resistance which the different tissues of the body offer to the passage of the X-rays depends upon difference in bulk and in chemical composition; organic substances made up of carbon, hydrogen and nitrogen which have a low atomic weight, allow the rays to pass readily, while those like bone, containing calcium, which has a comparatively high atomic weight, offer more resistance to the rays. The soft tissues of the body contain a large percentage of water, and most of them offer about the same resistance as an equal thickness of water. The various fluids found in the body in health and disease, such as blood, ascitic and pleuritic fluid, pus, urine, fluid from hydrocele, etc., offer about the same resistance as water.

The following experiment with calculi (see Fig. 1) illustrates in a striking manner how important to us is a knowledge of chemical composition in our use of the Roentgen rays in medicine. Before attempting to detect any form of calculi in the body, I first placed several different kinds over a photographic plate, which was enclosed in dark paper to shield it from the light, and exposed them for a few minutes to the X-rays. The rays penetrated the calculi made up of uric acid, of cholesterin and biliary salts very readily, but were obstructed by calculi containing oxalate of calcium, in considerable proportion, phosphate of cal-

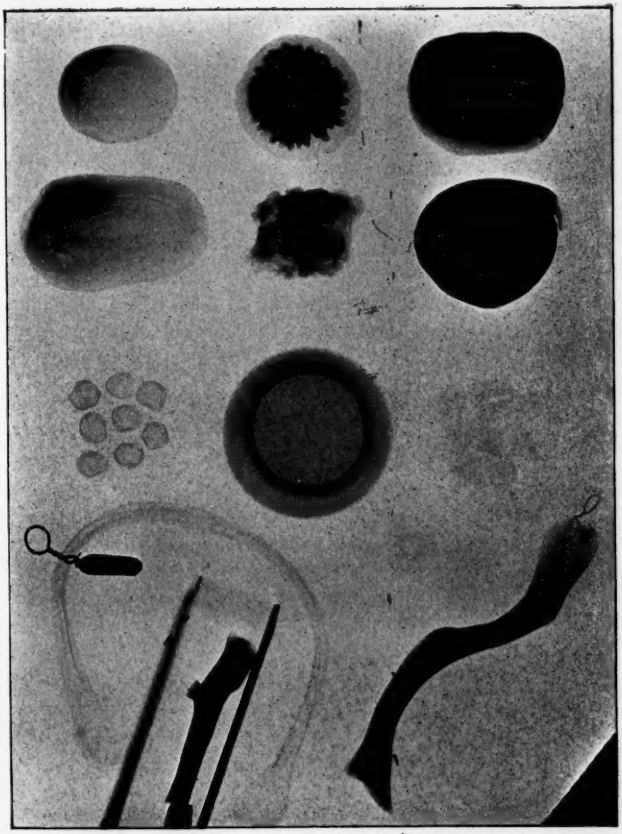


FIG. 1.—The two upper rows of objects in this radiograph are calculi. The two calculi on the left are composed of uric acid and urates; those on the right of phosphates; and the two in the middle of oxalate of calcium and uric acid, the upper one of these last two having an outside coating of urates. In the centre of the picture is a round aluminum cup, containing water, one inch in depth, and on either side of this cup is a group of gall-stones, and to the right and below the cup a single large gall stone is seen indistinctly. In the left hand lower corner is a decalcified bone, bent into the shape of Ω, with a lead tag attached by a copper wire. The decalcified bone surrounds an incinerated bone, which is lying on a piece of cotton wool in a wooden box with a glass side. In the right hand lower corner is a dry bone; in the extreme right-hand corner is a triangular piece of lead. The picture is reduced to one-third of its original size.

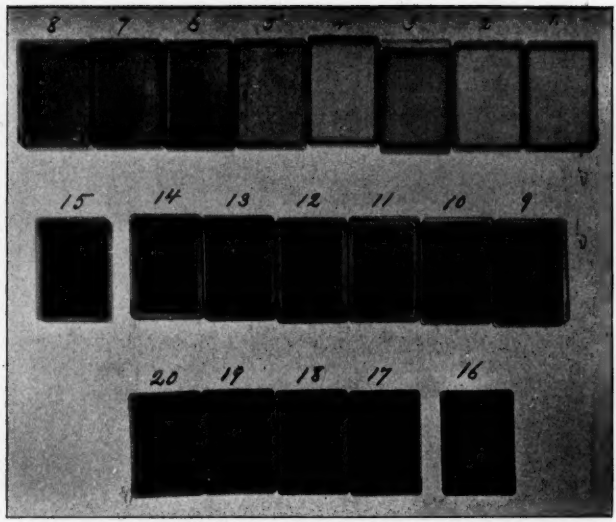


FIG. 2.—Radiograph of equal bulks of various substances which represent the constituents of the body in a general way.

	Weight.		Weight.
1. Carbonate of magnesium,	1.6 gram.	5. Gelatin	4. gram.
2. Stearic acid	3.8 "	6. Dried egg albumen	6.4 "
3. Oleic acid	3.5 "	7. Carbonate of sodium	5.9 "
4. Palmitic acid	4.4 "	8. Milk sugar	11.7 "
9. Glycerine	4. gram.	13. Phosphate of Calcium	2.6 gram.
10. Water	14. "	14. Sulphate of sodium	10.8 "
11. Oxalic acid	12.2 "	15. Magnesium ammonium Phosphate	12.5 "
12. Phosphate of sodium	10.6 "		
16. Chloride of sodium	8.5 gram.	19. Carbonate of calcium	15.3 gram.
17. Sulphur	13.9 "	20. Fluoride of calcium	11.7 "
18. Chloride of potassium	10.1 "		

cium, or other inorganic constituents. These calculi were kindly lent to me by Dr. William F. Whitney.

In order to gain some conception of the susceptibility of the various constituents of the body to the X-rays, I made several radiographs of a considerable variety of substances (see Fig. 2), and one of them I have had reproduced here.

There is one other point which must not be overlooked in this connection, and that is the difference in resistance which air and water offer to the passage of the X-rays. The rays pass through air much more readily than through water; and as air makes up a certain bulk of the body, a large part of the chest is filled with it, while water enters into the composition of all parts of the body and forms the chief constituent of the soft parts, it is readily seen of how much importance is this difference in permeability of air and water by the rays on account of the great contrast which is thereby afforded in health between the lungs and their adjacent tissues or organs. Further, as will be shown later, one of the best opportunities for the advantageous application of the X-rays is obtained from the contrast of the normal lung tissue with that offered by pathological conditions which occur in the thorax, involving chiefly increase in density in the lungs or in the space usually occupied by them.

To use the Roentgen rays successfully in practice, it is first essential that the physician become familiar with the appearances in the fluorescope which present themselves in health. This applies particularly to the thorax, and the picture of this part of the body when seen on the screen of a large fluorescope, presents so much, that it should be studied systematically. The trunk appears lighter above than below the diaphragm, and the rise and fall of this muscle, which is dark in the fluorescope, are distinctly seen. The chest is divided vertically by an ill-defined dark band, which includes the backbone, on each side of which the lungs, forming the brightest part of the picture, are crossed by the

darker ribs. This band varies in width according to the intensity of the light, narrowing as this becomes stronger; with a strong light the vertebræ from the neck to the heart are made out. The pulsating heart is seen, especially the dark ventricles, the outline of the venæ cavæ and of the pulmonary artery, and under favorable conditions the lighter right auricle. A small portion of one side of the arch of the aorta may be observed in the first intercostal space to the left of the sternum. After this general view has been taken, the outline of the lungs should be noted during full inspiration and expiration, and the excursion made by the diaphragm during quiet breathing, and during full inspiration and expiration (see Fig. 3).

The lungs usually appear brighter during deep inspiration; in young persons brighter than in older persons, as the tissues of the former are more easily penetrated by the rays. In the thin, the lungs appear lighter than in the heavy, because the outlines are dulled, as it were, by a thicker layer of tissues, which contain much water. It has seemed to me that the right apex is normally darker than the left apex. The normal brightness of the lungs, and the normal outlines of the clavicles and ribs should be observed, for, as we note different degrees of pallor by reference to our standard of color in health, in the same way is it necessary to know the normal amount of light which should penetrate any given part in order to recognize variations from the normal. The eye must be trained in the use of the X-rays as is the ear for auscultation and percussion, and the fluorescope, like the ophthalmoscope, should be in constant use in order that the practitioner may not lose any of the skill acquired in interpreting the conditions presented.

To test the possibilities of an examination with the fluorescope in certain conditions of the lungs, as when congestion or more or less œdema or pleurisy was present, I tried one or two simple experiments. On full inspiration in healthy

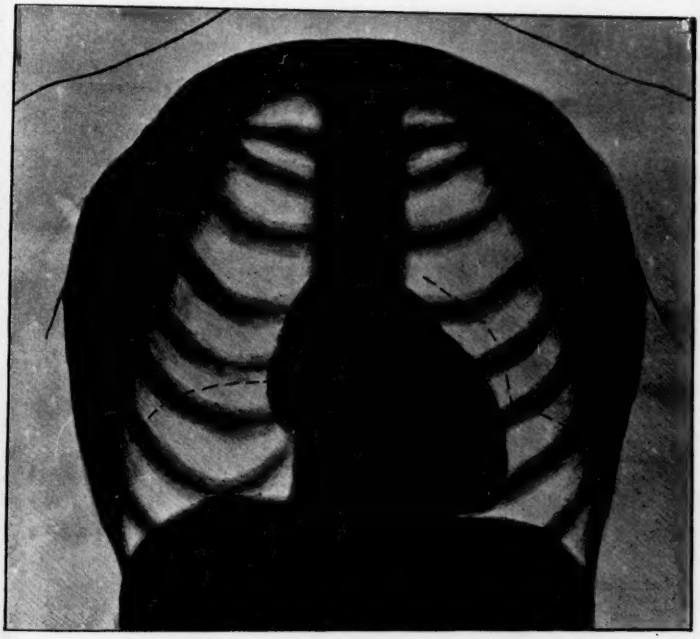


FIG. 3.— Diagram showing the heart and diaphragm of normal chest as seen in the fluorescope during full inspiration. The broken lines show position of heart and diaphragm in expiration.

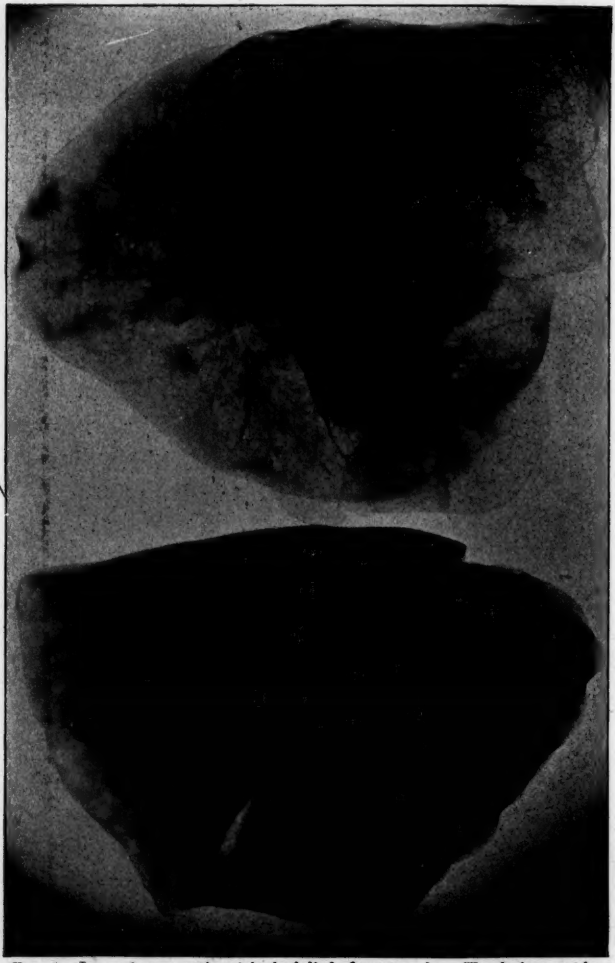


FIG. 4.—Lungs from a patient who had died of pneumonia. The darker part has been more affected by the pneumonic process than the lighter. The lightest portion is healthy.

persons I found the pulmonary area lighter than in other stages of respiration, and the ribs stood out in greater contrast, thus showing that there must be less blood in the lung during the former period, and that if any part of the lung is much congested, or if œdema is present, it would naturally appear darker than the normal lung; also, when I held a pasteboard box about one-half inch deep and full of water, over one side of the thorax of a well-developed and muscular man with a large chest, I could see its shadow in the fluorescope during about full inspiration, but not at other times.

In order to get further suggestions in regard to the possibilities of the X-ray examinations in diseases of the lungs I took a number of radiographs of healthy and diseased lungs just after death, which were removed from the body and put over a photographic plate. As a specimen of the latter see Fig. 4, which shows the lungs of a patient who died of pneumonia. The darker part was more affected by the process than the lighter; the lightest portion is healthy. These lungs were kindly sent to me for a few moments by Prof. W. T. Councilman.

Again, I examined with the fluorescope, two days before his death, the chest of A. B., one of my patients who died of syphilis, and found his lungs perfectly clear, and the outlines well defined. The outlines also of the front and back portion of the ribs forming a lattice work, as shown in the fluorescope, were well seen. The autopsy confirmed the examination made by the fluorescope, and showed that he had perfectly healthy lungs.

We shall see presently that in certain diseases, parts or the whole of one or both lungs appear darker or lighter than in health, and that their volume may be greater or less than in health. The respiratory excursion of the diaphragm may vary from the normal on either or both sides of the chest, in position; that is, it may be higher or lower in the

body, and in amplitude, or it may vary in curve, or its lines may be wholly or partially obliterated.

In making examinations of the lungs changes in the amount of light seen in the fluorescope should be carefully observed; for example, whether or not one lung is darker than the other. In pathological conditions the indications of change in density, shown usually by diminished brightness, may be estimated by comparing the two sides and observing whether the outlines of the organs, and whether the ribs and clavicles, are more clearly seen on one side than the other. When both sides are diseased the opportunity for direct comparison with the normal is lost, and one is obliged to depend upon the recollection of the normal in an individual of the same build. The position, excursion and curve of the diaphragm should also be carefully noted, as compared with the normal.

In six men with healthy lungs the diaphragm moved over an average range of two and three-fourths inches on the right side and two and one-half inches on the left side (see Fig. 5). The maximum excursion in any healthy person I have examined was four inches. In eighteen patients with tuberculous lungs the average excursion of the diaphragm was one and one-fourth inches. In some cases less than half an inch.

Patients may be examined standing, sitting or lying down, with the rays passing through the body antero-posteriorly, or from side to side. Most of my examinations have been made with the patients lying on a stretcher (see Fig. 6), and the Crookes tube on an adjustable holder under the patient. For careful examinations of the thorax, for example, the Crookes tube should be about two feet away from the fluorescope and its position should be determined by plumb lines, so as to bring it immediately under the sternum on a level with the fourth rib. The fluorescope is peculiarly applicable to moving organs, such as the heart

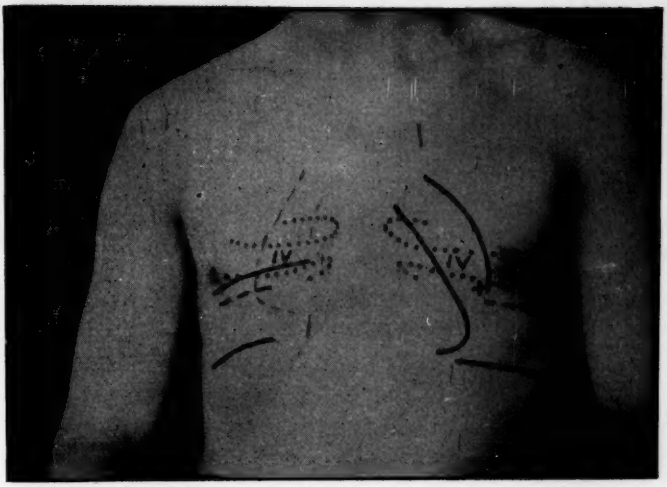


FIG. 5.—Chest of normal man, aged 21 years. Examination with the fluorescope: The dotted lines on each side of the chest indicate the outlines of the fourth rib; the full upper lines on either side of the chest about over the fourth rib, the position of part of the diaphragm in expiration; the broken lines just below these the height of the diaphragm at inspiration during quiet breathing; the full lines below and parallel to these the outlines of the diaphragm during deep inspiration. The full curved line, which is nearer the left nipple, indicates the left border of the ventricle during quiet breathing; the full curved line nearly parallel to this, the left border and apex during deep inspiration.

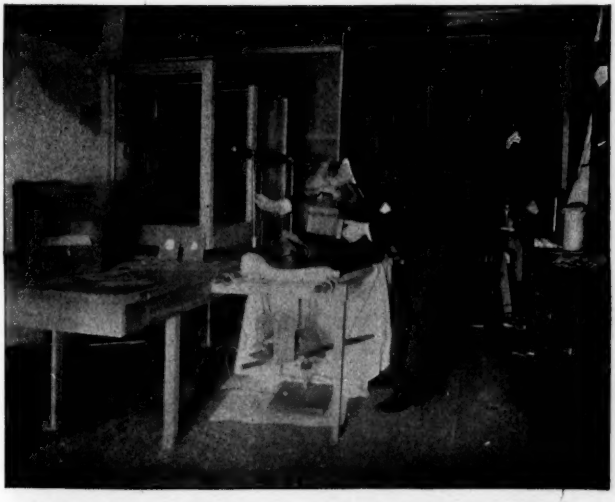


FIG. 6.—Static machine and stretcher, with tube holder below; large fluorescope at left of picture. This cut shows method of examining a patient.

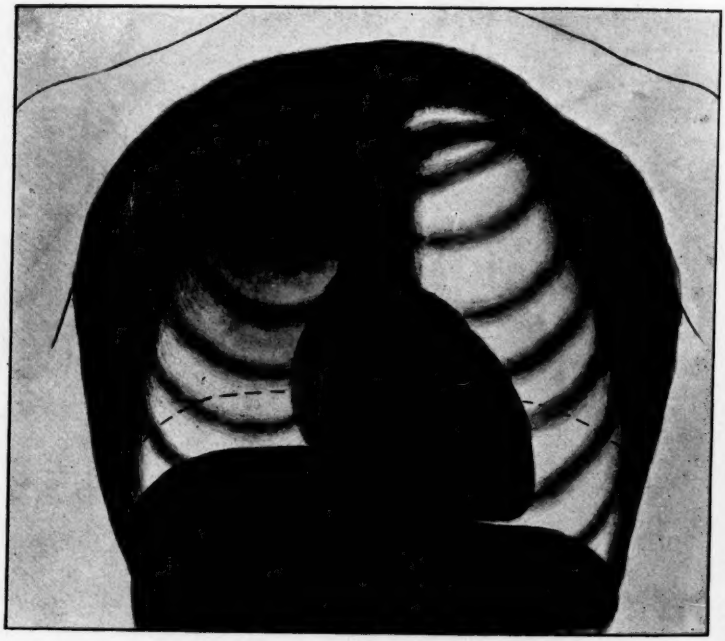


FIG. 7.—Diagram illustrating the appearances seen in the fluorescope in a case of tuberculosis. The apex of the right lung is seen to be darker than normal, and the range of movement of the diaphragm on the right side to be less than normal. The position of the diaphragm in full inspiration is shown; broken lines give its position in expiration.

and lungs, and is useful in examining children. I now use this instrument in my office as I do the stethoscope.

Let us now take up individually some of the thoracic diseases, and we will first consider pulmonary tuberculosis.

PULMONARY TUBERCULOSIS.

In this the fluorescope may suggest disease in the following ways: First, a diminution in the volume of the diseased lung is shown by the position and movement of the diaphragm. This movement may be less than normal on one or both sides and will be restricted on the lower side. Second, an increase in density by diminution in the normal brightness, the degree and extent varying in accordance with the increase in, and extent of, the density (see Fig. 7). The lung may become so dense that no more rays pass through it than through the liver. The brightness or light in the lungs indicates the amount of air in the chest. The diaphragm lines may be wholly or partially obliterated, as well as the outlines of the heart.

I have examined more than seventy-five cases of tuberculosis with the fluorescope, and found a correspondence between the physical signs and the X-ray examination in a considerable number of cases; in certain cases, this instrument showed that the disease was more extensive than the usual physical examination indicated; in others it showed increase in density in the lungs *earlier than was detected by the physical examination; and while in some of these no signs in the lungs were detected prior to those found by the fluorescope;* in others, although one lung was ascertained by the physical examination to be seriously involved, its companion was not suspected until the X-ray examination revealed its increased density. In most cases of pulmonary tuberculosis the fluorescope enables us to estimate the amount of lung involved better than any other method of examination. Most of the tuberculous patients I exam-

ined at the Boston City Hospital presented well marked signs of the disease when they entered, but in private practice the proportion of patients who are seen in the early stages, when there is greater opportunity for successful treatment, is larger, and therefore the fluorescope might be of special value in these cases on account of the earlier diagnosis it assists us to make.

The following case, which one of my colleagues kindly permitted me to examine with the fluorescope, shows that this instrument detected increase in density in the right lung when it was not found by auscultation and percussion. It likewise indicates the significance of the diaphragm lines.

H. A., aged twenty years. Tuberculosis? Duration, four weeks; family history not tubercular. Medium dry râles at left apex, with slight dulness. *Right apex normal.*

Examination with fluorescope: left lung extending to level of the fourth rib very dark; there is also some involvement of right apex. The maximum respiratory movement of the diaphragm on the left side is only $\frac{3}{4}$ inch; on the right side 1 inch only. This is less than half the normal.

[Later, tubercle bacilli were found.]

Let me also give the following case in which increase in density was detected earlier by the X-ray examination than by the other method. I examined this patient because he had a pericardial effusion, but the increase in density at the apex of the right lung was so marked in the fluorescope that it attracted my attention. The usual physical examination was then made, but I could find no evidence of phthisis. I examined the lungs in the fluorescope from week to week, and saw that the denser, diseased area extended, while the movements of the diaphragm became less and less on that side. After about six weeks the fluorescope showed that the left lung also had become denser at the apex, and the excursion of the diaphragm on that side was also les-

sened. No signs were found by auscultation and percussion on this side at this time. There has been no cough, the patient is about as usual in weight, has no night sweats, and no bacilli have been found, but about two months after his entrance to the hospital he reacted very strongly to tuberculin, and the diagnosis of tuberculosis was established. [This reaction is of much service in the diagnosis of tuberculosis in man as well as in cattle.] Four months after entrance, still no bacilli have been found, although many examinations for them have been made. There are, however, some cases where the bacilli are found before marked signs in the lungs can be detected in the fluorescope. It may be that the disease begins in the larynx in these cases.

Again, a woman twenty years old, unusually well developed and nourished, entered the hospital with phlebitis of the leg. Two of her sisters had died of tuberculosis. By auscultation and percussion the heart's area, action and sounds were normal; resonance and respiration good over the whole of both lungs. After she had been in the hospital two weeks, an X-ray examination was made, chiefly because I had established the routine of so examining many of my patients. This examination showed that the maximum movement of the diaphragm on the right side was one and seven-eighths inches, and on the left side two inches. The apices of the lungs were darker than normal on both sides, more so at the right apex than at the left. The outline of the heart showed that this organ was smaller than normal. Tuberculin was given, and was followed by a typical and well marked reaction. The tubercular family history, diminished movement of the diaphragm, increased density of the apices of the lungs and the small heart, all pointed to the diagnosis of tuberculosis, and this was confirmed by the tuberculin test. As yet there have been none of the ordinary symptoms or signs of disease of the lungs except those seen in the fluorescope.

We can detect an abnormal condition of the lungs in some cases of tuberculosis earlier by means of the fluorescope than by auscultation and percussion; how much earlier these signs can be anticipated depends upon the rapidity of the progress of the disease, and this varies in different persons and under different conditions. Of course, a diagnosis of tuberculosis is not made by the appearances in the fluorescope alone; they simply indicate an abnormal condition of the lungs. I shall consider more fully the use of the fluorescope in pulmonary tuberculosis in another article.

PNEUMONIA.

I have examined more than fifty cases of pneumonia with the fluorescope, and some of these, as already stated a number of times, while watching the progress of the disease, and found in a few cases that the lung had not become normal after months. In patients ill with pneumonia increase in density in the lungs is very marked in the fluorescope during the active stage of the disease, and by its means we may estimate how large an area of the lungs is involved, and by observing the patients at intervals of two or three or more days, as they improve, we may see the dark areas become lighter and lighter and finally disappear; and we may see the excursion of the diaphragm, which has been restricted, and restricted on the lower side, become gradually longer as the lungs clear up. I have examined patients while they were convalescent from pneumonia, both by auscultation and percussion, and by the fluorescope on the same day, and while by the former I could not detect that the lungs were denser than normal, I was able to recognize the continued presence of abnormal density by means of the fluorescope; and even when this was no longer possible, I could still easily see, by means of this instrument, that the diaphragm did not descend to its normal limit, thus showing that the lung was still in an abnormal state. Later the

normal limit was reached. This method of examination enables us to judge better than any other when the lungs have cleared up after an attack of pneumonia; and if we can obtain, by means of the fluorescope, later evidence of a pathological process, during its subsidence, than by auscultation and percussion, we may also reasonably expect to recognize its onset sooner, and I am satisfied that we can. Further, this ability to detect that the lungs are in an abnormal state weeks after a physical examination has ceased to indicate it, shows the delicacy of this test, and is an added assurance that we can in some cases of tuberculosis recognize an abnormal condition of the lungs earlier by means of the fluorescope than by auscultation and percussion.

I think that a slight pneumonia is at times overlooked when its early detection by the fluorescope might, in certain cases at least, prevent its progress to a more severe attack.

During the past winter, I have seen three patients where the diagnosis would have been difficult had not the fluorescope led me to that of central pneumonia; one of these cases had been seen by three physicians, and we all failed to make the diagnosis. Examination with the fluorescope caused me to make that of central pneumonia, and the further progress of the case confirmed it.

The following case shows the significance of the diaphragm lines in pneumonia.

L. B., aged ten years. Pneumonia.

Examination with fluorescope: On seventh day of disease, right lung dark from middle of first intercostal space to fourth rib; the upper and lower border of this dark area were definitely marked; outline in chest rather less clear than normal on both sides. Diaphragm moved $\frac{1}{4}$ inch on right side, and $1\frac{3}{8}$ inches on left side. Fifteenth day of disease, diaphragm moved 1 inch on the right side; $2\frac{1}{2}$ inches on left side. Nineteenth day of disease, diaph-

ragm moved 2 inches on right side; 2¾ inches on left side; original dark area on right side not so bright as other portions of the lung. On the twenty-second day of the disease diaphragm moved 2½ inches on right side, and 3 inches on left side.

The abnormal condition of the lungs in tuberculosis and pneumonia may be shown not only by the obstruction which the affected parts offer to the passage of the rays, but also by the restriction of the excursion of the diaphragm. In some cases the latter is a more delicate test.

PLEURISY.

In pleurisy with effusion we can estimate the amount of fluid in a general way by the amount of light which passes through the thorax, and can follow the subsidence of the fluid. When the effusion is large no more rays pass through it than through the liver, and the outlines of the diaphragm, ribs and heart are obliterated on the side of the effusion. If there is a smaller amount of fluid the outlines of some of the upper ribs are seen, and with a small effusion the outlines low down in the thorax only are ill-defined. The fluorescope assists us to distinguish between an effusion and a thickened pleura. In some cases of effusion the fluorescope shows us displacement of the heart, to the left when there is a large effusion on the right side, and a much greater displacement to the right, and this displacement is of more frequent occurrence when the effusion is on the left side. This displacement of the heart to the right may not be recognized by percussion even when it has been pushed much beyond its normal place. In one patient the heart was seen to be displaced more than two inches to the right, but no displacement was detected by percussion. While examining some cases of pleurisy with effusion by the fluorescope, I have found indications of tuberculosis in the lung where it was not previously suspected.

FIG. 8.—Emphysema. Dotted line marks cardiac area by percussion; full line by fluoroscope. Diaphragm lines in expiration and inspiration are shown on each side of the chest below the nipple; they are lower and nearer together than normal. Broken line below inner end of left clavicle shows arch of aorta.

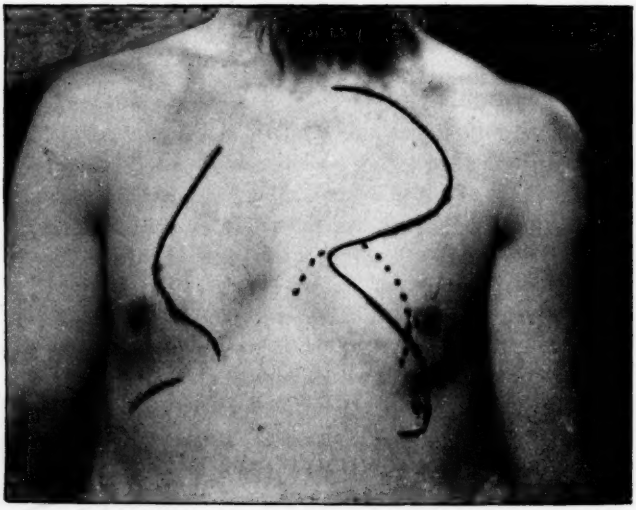


FIG. 9.—Thoracic Aneurism. Examination with fluorescope: The curved line in the upper part of the patient's left chest, and the curved line on his right chest, indicate the outline of the aneurism as seen in the fluorescope. The lower curved line on his left chest marks the outline of the heart; the lowest curve on the right front, part of the outline of the diaphragm. The dotted line, the cardiac area as determined by percussion. This case shows how a large aneurism may exist in the chest without giving rise to marked physical signs.

EMPHYSEMA.

In emphysema we see in the fluorescope that the lungs are unnaturally clear and that their volume is increased, the dilated right auricle and pulmonary artery are observed, and the whole enlarged heart is seen more clearly than normal, although by percussion its true outline cannot be determined; it is also seen to lie lower than in health and in the later stages in a more vertical direction. The diaphragm is seen to be lower than normal, and the excursion which it performs between deep inspiration and expiration to be less than normal (see Fig. 8). In some cases the emphysematous condition may be greater on one side than the other. The lower position and the more limited excursion of the diaphragm give a means of making a diagnosis of this condition probably earlier than has hitherto been possible, or in some cases the lack of these signs enables us to exclude it.

The following case was sent to me with a diagnosis of emphysema with asthma:

B. F. Examination with fluorescope: diaphragm moved on the right side two and one-half inches and on the left side three inches. The excursion of the diaphragm being normal assures us that no serious amount of emphysema was present.

I have seen patients, both young and old, who complained of getting out of breath on exertion, and the cause in some cases would have been obscure but for the fluorescope, which showed that the dyspnœa in both young and old was due in some instances to emphysema, in others to œdema of the lungs.

If some other disease is associated with emphysema, as for instance some form of bronchitis, the excursion of the diaphragm is characteristic but the abnormal clearness of the lungs may be wanting.

BRONCHITIS.

The appearances of bronchitis in the fluorescope vary; they may differ very little from those in health, or both sides of the thorax may be less bright than normal. The respiratory movement of the diaphragm was not especially impaired in the cases I have seen.

PNEUMOTHORAX.—HYDROTHORAX.—PNEUMOHYDROTHORAX.—PNEUMOPYOTHORAX.—ŒDEMA OF THE LUNGS.

In pneumothorax the fluorescope shows that the affected side of the chest is lighter than normal, that the heart and vessels may be much displaced, and that the diaphragm is much lower than normal on that side, and has a characteristic curve.

In pneumohydrothorax or pneumopyothorax, when the patient is examined lying down, the whole affected side of the chest is seen to be dark; if examined in a sitting position the upper portion of the chest is clear and the lower dark. The appearances remind one of a tumbler half full of ink; when the patient bends forward or backward the height of the fluid on the chest wall changes; if the patient is shaken gently the surface of the dark fluid is seen to be agitated. In pneumohydrothorax or pneumopyothorax on the left side the surface of the fluid is seen to be disturbed by the pulsation of the heart.

In hydrothorax and œdema of the lungs the fluorescope is also of service. In these conditions, as well as in empyema, the outlines of the diaphragm are wholly or partly obliterated. Some partial œdema of the lungs is, I am inclined to believe, a more frequent condition than has been supposed. On first examining a patient of this class, his condition being unknown, I was surprised to find how difficult was the passage of the rays, and when I saw that

the picture of the patient's thorax in the fluorescope was unusually dark, supposed something was wrong with my Crookes tube; but after trying another I realized that the patient's chest was denser than normal; the tube was not in fault. I have examined a number of cases which illustrate the aid the fluorescope renders in congestion or œdema of the lungs; this instrument showed that one of these conditions was present when it was not made out by physical signs, and it thus assists the physician to recognize the interference that occurs in the pulmonary circulation in cardiac or renal disease.

I have found it instructive to study, by means of the fluorescope, cases of dyspnœa on exertion, and note the amount of congestion or œdema of the lungs present in them. Cases of this kind have already been referred to under emphysema.

H. E. Twelve years old. Entered the hospital with endocarditis following rheumatism. There was a systolic souffle at the apex of the heart transmitted to the axilla, enlarged heart, orthopnœa, œdema of the lungs and intense dyspnœa. Digitalis given. Three days after entrance the examination of the fluorescope showed that the lungs were denser than normal below the second rib on the right side and the third rib on the left side. Four weeks later a second examination with the fluorescope: lungs perfectly normal, heart smaller; patient had been up and about for some time.

ANEURISMS.

I have examined with the fluorescope and have taken radiographs of one subclavian and several thoracic aneurisms. The heart in some of these latter cases was much displaced. Aneurisms of the arch of the aorta are most clearly outlined when their borders are nearest the fluorescope; those on the left when examined from the back, those on the right

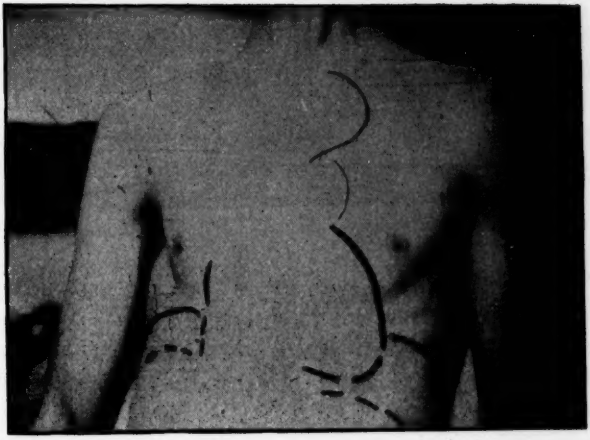
when examined from the front. It is obvious that aneurisms of the thoracic aorta can sometimes be detected earlier by an X-ray examination than in any other way. In obscure thoracic cases, where an aneurism of certain portions of the aorta is suspected but does not exist, it may be excluded by an X-ray examination.

I have recently seen in consultation a patient who had had excellent advice in Boston and New York, as well as elsewhere, and the diagnosis was obscure until my X-ray examination showed an aneurism of the aorta; in another case my X-ray examination showed that there was no aneurism where it was thought to exist.

THE HEART.

Let us now consider the position, size and movement of the heart in health, as shown by the fluorescope, before taking up some of the applications of the X-ray examinations in cardiac diseases. The best view of the heart is obtained during full inspiration, as then the diaphragm is so depressed as to expose a much greater part than during quiet breathing, and with more air in the lungs the outlines of the heart stand out better on account of the greater contrast thus produced. On the left side of the sternum the objects most clearly seen are a considerable part of the ventricles, including the apex, and the pulmonary artery; on the right of the sternum a large part of the right auricle and the right border of the venæ cavæ.

When the space occupied by the lungs is in a normal condition, the outline of the portion of the heart on the left of the sternum can be followed by means of the fluorescope with more certainty and accuracy and more fully than by percussion. The lower border of the heart near the apex is not obtained by percussion, but part of it is seen in the fluorescope during deep inspiration. Also on the right of the sternum the position and size of the right auricle, although it is



FIGS. 10 and 11.—Show a smaller aneurism of the aorta.

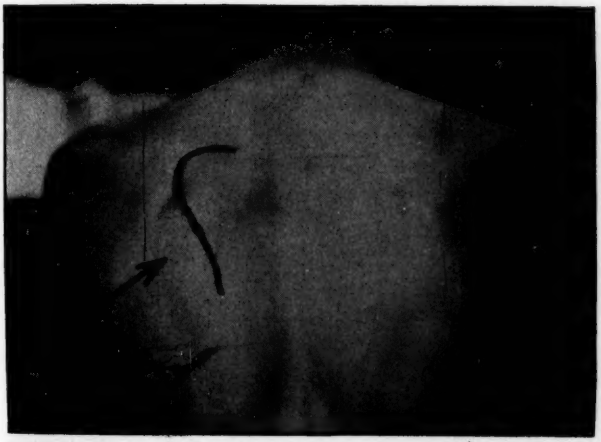


FIG. 11.—The arrow points to where the pulsation was best seen.

not distinctly outlined, can be better ascertained by the fluorescope than by other means; likewise the right border of the venæ cavæ, which is much more marked in the fluorescope than the right auricle; but the right border of the ventricle, being behind the sternum in health, is then better determined by percussion than by the fluorescope.

The position of the heart varies in health in different persons; with deep inspiration it moves downwards and toward the median line, nearly an inch. While watching the pulsations of the heart in the fluorescope I observed that the most marked changes in the outlines were not at the apex but at the left side at the point corresponding to the cavity of the ventricle, the maximum pulsation being about where the outline of the ventricle crosses the fourth rib. I could see the ventricle contract and expand as it emptied and filled.

The change in the position of the heart, due to conditions outside of itself, such as pleurisy with effusion, pneumothorax, emphysema, etc., as already stated, may be seen in the fluorescope, or the change in position due to its own enlargement. We may recognize, for example, enlargement of the ventricles, and see a dilated right auricle and pulmonary artery and pulsations of the venæ cavæ. Differences in size may likewise be observed; for instance, the diminution which is found in anæmic patients with tuberculosis, or increase in size which takes place in hypertrophy, or dilatation.

The ability to observe such changes as the above enables us to obtain a more accurate knowledge of the condition of the heart in disease than has hitherto been possible.

The so-called apex beat, which physicians use so much as a point of reference in examining the heart, is not the apex beat in all cases, but an impulse given by the side of the ventricle; the apex of the heart is then seen in the fluorescope to be lower down, usually much below the point where the impulse is felt on the wall.

Calcareous deposits may be seen in some cases, but at present only when the disease is unusually well marked. In one of my patients I saw a dark area in the aorta and in portions of the heart contiguous to it, which were pushed over to the right of the sternum. The autopsy showed that the dark area seen in the fluorescope was a calcareous deposit.

The fluorescope assists us to make a differential diagnosis between pericardial effusion and an enlarged heart; not only are the outlines seen to be different in the two cases, but in pericarditis with much effusion the characteristic pulsations of the heart are not seen.

In some diseases of the heart its outlines, to the left of the sternum, as found by percussion, are not correct. In order to compare the size and position of the heart, as obtained by this method, and as seen in the fluorescope, I drew on the skin the cardiac outlines found by percussion, and directly afterwards these outlines as seen in the fluorescope. I have done this in about thirty cases. Both sets of outlines were then traced on tracing cloth, held carefully over the skin, the one in red and the other in blue lines. (In other patients I photographed the two sets of lines.) Comparison between these lines showed that in some cases the outlines obtained by the two methods, namely by percussion and by the fluorescope, agreed very well; in others the difference was marked. It should be stated, however, that although percussion does not indicate in some cases the true size and position of the heart, a proper examination of this organ with the fluorescope is difficult to make, needing careful adjustment of the X-ray apparatus and experience with a considerable number of cases.

I have used several methods for recording the outlines of the heart seen in the fluorescope; one record is made by means of a flexible, fluorescent screen which has a smooth surface like a porcelain slate. The screen is placed on the

chest of the patient, the room is darkened and the outlines traced with an ordinary lead pencil. These lines may be afterwards rubbed out with a moist sponge and the screen used again. Another method, alluded to above, and one which allows of a ready comparison of results, is to draw the outlines of the organs on the skin by means of a special pencil while looking through the fluorescope, and then to place a piece of tracing cloth, about a foot square, on the chest and trace upon it the outlines that have been made on the skin. It is well in these tracings to include the sternal notch, the nipples, the fourth rib, the ensiform cartilage and the border of the ribs on either side and below the latter, as these serve as points of reference and comparison. Care must be taken that the tracing cloth be held smooth and that the skin be not moved or stretched. These cloth tracings may be placed, one over another, and readily compared, as, for instance, the normal with the abnormal, or the size and shape of the heart in different diseases, or at different times in the same disease.

In the mediastinum new growths or abscesses may be expected to give evidence in the fluorescope of their presence by displacing the vessels and changing the normal outlines of the latter before they are large enough to be themselves seen by means of this instrument.

I wish to point out the advantages that will follow a study of carefully made radiographs. I have taken radiographs that indicate, for example, adipose tissue, and the outlines of muscles, tendons and arteries in healthy persons, both children and adults.

SUMMARY.

No harmful effects have been received by the patients—more than five hundred in number—that I have examined by the X-rays.

The varying resistance which the different tissues of the

body offer to the passage of the Roentgen rays depends upon difference in bulk and in chemical composition.

The difference in permeability of air and water by the X-rays is of great importance in thoracic diseases.

The normal brightness of the chest having been observed in the fluorescope, a departure from the normal in two directions may be noted by comparison. First, a given part of the chest may be darker than normal on account of the obstruction offered to the passage of the rays, which is due to the *increase* in density that occurs in tuberculosis, pneumonia, infarction, œdema, congestion of the lungs, aneurisms and new growths, or to fluid in the pleural and pericardial sacs that occurs in pleurisy with effusion and pericarditis with effusion; the distribution, location and amount of this increase in density, which the fluorescope shows, assist us in some cases to distinguish between these diseases or conditions. Second, a given part of the chest may be brighter than normal, because it is *more* permeable than in health by the rays on account of the *diminution* of density, due in the case of emphysema, to increase in the amount of air in the lungs, or in the case of pneumothorax, to increase in the amount of air entering the pleural sac and displacing the lung.

Importance of the diaphragm lines: the normal diaphragm lines on both sides of the chest (these include position, excursion and curve of the diaphragm, and the clearness with which they are seen) having been observed in the fluorescope, departure from the normal may be noted by comparison. In tuberculosis and pneumonia the excursion of the diaphragm is restricted, and restricted on the lower side; in emphysema, on the contrary, although the excursion of the diaphragm is restricted, it is restricted on the upper side,—the diaphragm goes lower down toward the abdomen, and in pneumothorax on the affected side it has a characteristic curve and moves only on its median end. In tuberculosis, pneumonia, pleurisy,

hydrothorax, empyema, and œdema of the lungs, the diaphragm lines, as well as those of the heart, may be wholly or partially obliterated owing to the abnormal density of the lungs in their lower portion. In some cases of tuberculosis and pneumonia the lessened range of movement of the diaphragm is a more delicate test than the diminished brightness of the lungs. The normal outlines of the diaphragm may also be changed by an abscess or new growth contiguous to it.

The fluorescope gives us better assurance that the lungs are in a healthy condition than other methods of physical examination, and in connection with auscultation and percussion teaches us to interpret better the signs found by the older method.

The fluorescope gives us earlier evidence of disease in some cases of tuberculosis and more accurate information of the extent (this affects the prognosis) than can be obtained by the usual physical examination.

The fluorescope gives us more accurate information of the extent of the disease (this affects the prognosis) in pneumonia and of the duration of an abnormal condition of the lungs.

The fluorescope shows a displacement of the heart in pleurisy, which is sometimes not recognized by other means, and assists us to recognize and estimate the amount of fluid in the pleural and perdicardial sacs.

The fluorescope enables us to recognize and exclude emphysema.

The fluorescope enables us to make a diagnosis in some cases of dyspnœa that would otherwise be obscure.

The fluorescope assists us to recognize œdema of the lungs, pneumothorax, hydrothorax and pneumohydrothorax.

The fluorescope gives us the means of making an earlier and more certain diagnosis in some cases of thoracic aneurism than any other method, and enables us in some cases

to exclude it where it has been suspected, but is not present.

The fluorescope enables us to outline the heart more accurately and completely than has hitherto been possible, and to observe certain changes in it; and it especially assists us to a more accurate determination of its size, movement and position in disease, and in some cases to observe not only the heart as a whole, but the auricle and ventricle separately. Further, it enables us to recognize earlier associated conditions, such as œdema of the lungs, and assists us to recognize pericardial effusion.

We may sometimes make a diagnosis by an X-ray examination alone, in certain cases of aneurism and emphysema for example; but it is, as a rule, only one method of examination, and its value in assisting us to establish a diagnosis varies of course in different diseases. The X-ray examination should be used in connection with other methods. The information derived from it, in suitable cases, is more definite and accurate than that obtained from auscultation and percussion. The fluorescope and the stethoscope aid each other.

As is the case with all other observations on which a diagnosis is founded, the conditions which are revealed by the fluorescope are to be rightly interpreted only after experience in making X-ray examinations has enabled the physician to give these observations their proper weight.

I have had the privilege of studying the physics of the X-rays in the Rogers Laboratory of the Massachusetts Institute of Technology, and I am under obligation to Professor Charles R. Cross and two of his assistants, Mr. C. L. Norton and Mr. R. R. Lawrence, for their coöperation. I also desire to express my appreciation of the active interest taken by the trustees of the Boston City Hospital in my work, and the kindness of my colleagues on the staff for affording me an opportunity of examining many of their patients.

ARTICLE XXXV.

PALLIATIVE AND OPERATIVE TREATMENT OF FISTULA IN ANO.

By JOHN B. BLAKE, M.D.
OF BOSTON.

READ JUNE 9, 1897.

PALLIATIVE AND OPERATIVE TREATMENT OF FISTULA IN ANO.

FISTULA in Ano is, next to hemorrhoids, the commonest of the diseases of the rectum, and is one of the minor surgical conditions with which the surgeon is most frequently confronted. It varies extremely in ætiology, extent and symptomatology. It affects all ages and all classes, and for obvious reasons is often of months, or even years, duration before being brought to the attention of the surgeon. It is more frequent in males than in females. An examination of the records of the Boston City Hospital shows that cases have been operated upon in that institution from one year to seventy-five years of age; these extreme limits are rare, and children are seldom afflicted with fistula. Of one hundred cases recently operated at the Boston City Hospital, three were in patients less than twenty years old; forty-two were between twenty and thirty years; twenty-six between thirty and forty years; seventeen between forty and fifty years; and twelve were more than fifty. Sixty-eight per cent. therefore were between the ages of twenty and forty; and the disease is most common, or at all events it seeks treatment most commonly, between these ages.

DEFINITION.

Gant defines fistula in ano as a "non-granulating sinus of the ischio-rectal fossa, usually with two openings." It need not necessarily open into the rectum, though it usually

does so, and it is almost always in relation to the rectal walls.

ETIOLOGY.

By far the commonest cause of fistula is an inflammatory process, originating in the rectum or its neighborhood; that is, a proctitis, peri-proctitis, or an ischio-rectal abscess. Certain English writers assert that these are the only causes. This, however, is not true. Among other causes are fissures and ulcerated hemorrhoids, tubercular processes of rectum or ischio-rectal fossa, trauma, foreign bodies, such as fish bones, necrosis of sacrum or coccyx, and worms, especially in children. Finally, there are causes which should, perhaps, be classified as predisposing rather than exciting, such as constipation, or alternate constipation and diarrhœa, lack of cleanliness, and the heat and congestion and atony which the softness of cushions and modern chairs and the frequency of the sitting posture tend to develop in this region. Many surgeons believe this latter to be a fruitful source of fistula and hemorrhoids.

VARIETY AND TYPES.

It is not necessary to do more than mention the commoner types of fistula, such as the *complete*, the *blind internal* and the *blind external*. The rarer forms may be briefly described.

A horse-shoe fistula is one which extends to a greater or less degree on both sides of the anus, and usually opens into it in one or more places. It most commonly passes behind the anus. Its shape is due simply to the peculiar burrowing course of the pus. Complete internal and complete external are names given to fistulæ with two openings, both of which are situated inside the rectum in the first case, and outside it in the second. Certain writers describe complete fistulæ anatomically as *anal* and *rectal*, the former opening into the bowel low down, the latter at the level of, or above, the internal sphincter.

EXTENT.

Fistulæ differ enormously in extent. Length, depth, direction, branching, inter-communications, and relations to anatomical landmarks, all vary within extreme limits. All degrees are found, from a single external opening to a series of sinuses which riddle the ischio-rectal fossa, or break into the rectum, bladder or vagina. The difference between extreme types is enormous. The superficial fistula which involves only the margin of the external sphincter differs as much from one which has perforated the levator ani muscle, and invaded the pelvis, as does a mild catarrhal appendicitis from a fulminating case; and the severity of the operation and the length of convalescence vary accordingly.

SYMPTOMS.

The symptoms are usually unmistakable and the diagnosis obvious; but the precise determination of the extent of a fistula can never be made with certainty until the operation. Neither the duration of the symptoms, nor their intensity, nor the position or number of the orifices, can be depended upon as unerring guides in this regard. It is for this reason often impossible to give a definite prognosis before the operation.

Blind internal fistulæ are often as hard to diagnosticate as to demonstrate. Symptoms are often vague, and are usually soreness and a dragging sensation in the rectum at a varying distance from the anus, and a dull burning pain, usually increased after defecation. There may or may not be a discharge from the rectum. On digital or visual examination it is often impossible to demonstrate an opening. Such a fistula may accompany hemorrhoids, prolapse, or even fissure, unsuspected by the patient.

ANATOMY.

Anatomical considerations modify the treatment, and may

at times dictate it. The important landmarks will, therefore, be briefly described.

The perineum is a rhomboidal area, of which the inferior edge of the symphysis pubis, and the coccyx, form the anterior and posterior extremities, and the tuberosities of the ischium the lateral angles. The great sacro sciatic ligaments extend from the tuberosities to the coccyx, making the posterior sides of the rhomboid, and the rami of the ischium and pubes form the anterior sides. The anterior half of this region is usually described as the perineum proper, and the posterior half as the ischio-rectal fossa. The roof is formed by the levator ani muscle, which is also the floor of the pelvic cavity.

The rectum is usually described in three parts, of which only the second and third are concerned in fistula. The second part begins at the top of the fourth sacral vertebra and extends to the upper margin of the internal sphincter. It rests upon the anterior surface of the sacrum, and is concave forward nearly to its lower extremity, where it turns abruptly backward over the lower end of the coccyx. Within it is sacculated and presents most of the anatomical characteristics of the large intestine. It is partially covered with peritoneum which extends further down on its anterior than on its posterior aspect, and finally leaves the rectum in the male about one inch above the edge of the prostate. In front of the rectum is the bladder in the male, and the vagina in the female. The depth of the pouch of the peritoneum in front of the rectum varies in different individuals, and at different times in the same individual, being higher when the bladder and rectum are full. In rare cases it may come close down to the prostate. This must be borne in mind when following up a deep anterior fistula.

The third part of the rectum, or anal canal, is straight and directed backward and a little downward. In life it is a slit, the walls held snugly in contact by the sphincters.

The anus itself is elliptical, more so in males than in females, its long diameter being antero-posterior. In the female it is usually smooth and funnel shaped, and free from hair; in the male it is wrinkled and covered with hair. Just beneath the skin at its margin are the thin radiating fibres of the corrugator cutis ani.

The external sphincter is elliptical, and is attached behind to the coccyx and in front to the tendinous centre of the perineum. In the female the fibres decussate anteriorly, and are continuous forward with the sphincter vaginæ. It is a thin flat muscle, and not a true sphincter. It closes the anus rather by approximating its lateral walls than by a circular contraction. It also pulls the coccyx forward, or helps to anchor the tendinous centre of the perineum.

The internal sphincter is a firm thick rim of muscular fibres, produced by the increased development of the circular fibres of the rectum. It is a muscle of great strength, and upon its integrity depends the effective closing of the bowel. It is from one half to one inch in depth, and is not connected with any bony landmark.

The levator ani is an important muscle forming the roof of the ischio-rectal fossa and the floor of the abdominal cavity, and has been not inaptly called the diaphragm of the pelvis. The rectum passes through it at its lowest point in somewhat the same manner that the œsophagus passes through the diaphragm. The levator ani arises anteriorly from the back of the pubes, posteriorly from the spine of the ischium, and laterally from the so-called white line of the obturator facia which connects these two. From this broad origin the fibres pass downward, backward and inward, to the tip of the coccyx, the sides of the rectum and the sides of the prostate or vagina. On the superior surface, only the pelvic fascia is interposed between it and the peritoneum. As it forms the roof of the ischio-rectal fossa, and slopes downward, it is obvious that the fossa is deepest away from the

rectum, and becomes progressively shallower as the anus is approached. The action of the muscle is to lift the anus and second part of the rectum after it has been lowered or everted in defecation. It is also a muscle of forced respiration, and a landmark of extreme importance in the operation for fistula.

BLOOD SUPPLY.

The blood supply is from several sources, but mainly from the inferior hemorrhoidal branches of the internal pudic, and the middle hemorrhoidal of the internal iliac as well as the superficial and transverse perineal arteries.

The veins form the hemorrhoidal plexus, and are numerous and large. They are without valves, and are prone to become varicose.

The congestion of the region is increased by its anatomical position and by the character of these veins.

It is necessary to mention the deep and superficial perineal fascia, and the triangular ligament before leaving this subject, as it sometimes happens that a deep fistula burrowing anteriorly through the levator ani muscle comes to lie above this ligament, and has been known to dissect its way anteriorly and actually point into the thigh.

TREATMENT.

The treatment of fistula, like the treatment of any other condition, must be directed towards the removal of the cause. It may be divided into palliative and operative, and by far the greater part is operative. Some writers go so far as to doubt the value of palliative treatment in any case of fistula whatsoever, and others restrict it to occasional cases of the most trivial character. On the other hand, the cure of fistula "without the knife" is extolled in numerous advertisements, and in every city there are so-called medical men who have apparently made large fortunes by following the palliative treatment exclusively.

It seems to be the opinion of the majority of writers and operators that there is a certain small and definite class of cases in which the non-operative treatment may be advised and followed with a good prospect of success. But it must be admitted that even in cases which seem to fulfil all the indications for non-operative treatment, a certain percentage will remain uncured, or will relapse.

The non-operative methods are numerous, but all may be classed under one of the following heads:

NON-OPERATIVE.

1. Simple cleanliness.
2. Dilation of external opening and packing with gauze.
3. Application of caustics.
4. Introduction of ligature, preferably elastic.

The cases to which any of these methods are applicable are those not attended with acute inflammation, or the presence of much pus; those which are not extensive; those which present a direct tract, without diverticula or branches; those which do not extend through the levator ani muscle; and, probably also, those which are not tubercular, or which do not show symptoms of being tubercular, though to the exclusion of this latter class some writers would disagree.

It is obvious that this classification limits to a marked degree the non-operative treatment; but beyond these limits the writer is convinced that palliative treatment at present should not be advised or undertaken. Exception, of course, is made of those rather rare cases in which on account of age or the general condition of the patient there is a definite contraindication to operation, or in which the patient refuses operation, and desires treatment, which is given with the distinct understanding that it will probably be insufficient.

CLEANLINESS.

It is a fact that certain superficial or marginal fistulæ fol-

lowing fissures, or slight trauma, or very small abscesses, may heal, and heal permanently, if left to themselves and kept perfectly clean. Such cleanliness, however, must be persistent and scrupulous. Not only must the parts be washed at least once daily, and more often in warm weather, but they must be cleansed carefully after each movement of the bowels, and should be irrigated with some mild antiseptic or astringent, such as myrrh wash, or dilute liquor plumbi subacetatis. After the washing they must be made, and what is of great importance, maintained, perfectly dry. After wiping out the sinus, filling it with some inert powder, or with powdered boric acid, is at times of undoubted benefit. Such treatment is monotonous and necessarily of long duration. The cases are rare in which it could be advised, and the patients who would carry it out are still rarer.

PACKING WITH GAUZE.

If packing with gauze is added to the cleansing described above, we have a method which will undoubtedly be sometimes followed by success. The method is common enough in the sinuses which follow operations in other parts of the body, and owes whatever efficiency it possesses to the cleansing which precedes it, and to the slight irritation to the sides of the sinus to which the packing gives rise. If carefully and conscientiously carried out, it compels whatever healing takes place to progress from the bottom of the sinus upward, and it prevents pocketing of the discharge; it also helps to prevent the introduction of dirt either from the rectum or externally. Gentle dilation of the external orifice, with dressing forceps, or director, will facilitate the introduction of the gauze and the escape of the discharge. The frequency of the dressing varies with the amount of discharge, but will average approximately once in two days. Care must be taken not to pack too frequently or too solidly, as the former may mechanically interfere with healing, and

the latter destroy the drainage. Iodoform gauze is unquestionably the best material, though baked gauze dusted with nosophen or aristol is also good.

CAUSTICS.

The application of caustics is a direct step towards removal of the cause of the fistula, and exciting union by adhesion or counterirritation. All sorts of caustics have been recommended. Until late years nitric acid has been much used. It has been supplanted by ninety-five per cent. carbolic acid, which presents decided advantages over it—among others, that of being far less painful, and of being able to act efficiently without the formation of so deep a slough. The fistula should first be cleansed by the injection of peroxide of hydrogen in 15–30 volume strength, or of permanganate of potash, and dried. A wisp of absorbent cotton is tightly wrapped about the end of a fine probe or wire, previously moistened a little to help the cotton to adhere. The cotton is saturated with ninety-five per cent. carbolic, and introduced into the sinus to the bottom, or to the internal orifice, and is then rotated and rubbed against the sides. Care is taken to prevent the healthy skin in the neighborhood from being moistened with the acid. The writer has usually applied the acid once in three days, but it is probably better to apply it oftener. In two or three cases the progress at first was rapid and satisfactory, but later on the more superficial part of the sinus was more obstinate in healing. In one case it failed entirely, though it is only fair to say that this case had been operated on before, and has since been operated upon again, and is still not entirely healed. It was a good example of a case in which the palliative treatment should not be advised. It was undertaken as an experiment. Sinuses without greatly thickened walls are particularly favorable for this method of treatment.

The objections to this method are the possibility of using too great a quantity and producing too deep a slough. In obstinate cases it may be advantageously combined with a packing of gauze.

LIGATURE.

The use of some sort of ligature for the cure of fistula has been recommended for centuries. Various materials have been used—linen setons, silk thread (sometimes moistened with caustic) and elastic ligatures. Whatever advantage this method of treatment may offer, it is certain that the elastic ligature possesses more of the qualities necessary for success than any of the others. Celsus has given an accurate description of the elastic ligature, and in recent years Dittel of Vienna and Allingham have brought it prominently before the medical world.

The elastic ligature is the means most commonly employed by those who advertise to cure without the knife. It seems to offer to the timid or busy patient a relief from his uncomfortable condition, without operation, pain or confinement to bed. It is needless to add, that if it had made good such promises, it would have revolutionized the treatment of fistula shortly after its introduction. The elastic ligature in the past, however, has been not without its dangers. One case in which it was used died with the symptoms of septicæmia, and two others developed secondary abcesses, though they were purposely confined to bed in the hope of avoiding such complications. These cases occurred some years ago, however, and since then the elastic ligature has been employed at the Boston Dispensary and at both the hospitals in Boston with perfectly satisfactory results.

Dr. J. C. Stedman reports no less than a dozen cases satisfactorily treated and cured without unpleasant symptoms by elastic ligature.

Elastic ligatures are strands of pure india rubber from

$\frac{1}{26}$ to $\frac{1}{8}$ of an inch in diameter. Round ligatures have been recommended, but the square rubber thread, used to make webbing, answers the purpose perfectly. English writers advocate the larger sizes, such as a $\frac{1}{10}$ inch in diameter, but most Americans prefer the small ligatures.

The cases adapted for its use are complete fistulæ, of not too great a depth, without diverticula and past the stage of acute inflammation. Here, again, English writers differ from Americans, in recommending its use in deep fistulæ, as an adjunct to the knife, making the final cut through the internal sphincter by the elastic ligature, after the superficial tissues have been divided by the knife. In this way, Allingham thinks he causes less injury to the sphincter, and is certain that he has less bleeding.

The operation consists of passing the ligature through the fistula, and fastening the ends tightly together. The only difficult part of the operation is the introduction of the ligature. For this purpose several needles and probes have been devised, and Allingham has invented a formal suture carrier on a handle in which the end of the ligature is carried through a guarded eyelet. These instruments are unnecessary as a rule. The writer in one case passed the ligature easily, by simply bending down the tip of the ordinary silver probe over the end, then passing the probe and ligature through the fistula. The ligature is then put on the stretch, and either tied or, what is more easily done, caught between the edges of a split shot, which is then compressed by means of a strong pincers. It is at times advisable to dilate the sphincter gently, and it is often surprising to find how much the sphincter can be dilated without pain, if much care and a little time be devoted to the task; this is, of course, in the unetherized patient.

The ligature should be drawn as tight before fastening as its strength will allow, and it is best to test this before in-

serting it. If the fistula be a deep one, it is sometimes advisable to insert a small piece of gauze between the shot and the skin, to spread the pressure over a little greater area.

The ligature cuts out in from five to ten days, the fistula healing behind it, sometimes with remarkable rapidity; the tract at times is more than half healed before the ligature comes away. The pain varies a good deal; it may be very slight after the ligature is once introduced; at times the patient is compelled to use a quarter grain morphine suppository and go to bed. The pain rarely lasts more than forty-eight hours. As a rule the patient may be on his feet the entire time.

If appropriate cases are chosen, a very large percentage will be followed by a perfectly satisfactory result. Allingham says he has not found the ligature as effective as he at first thought it would be; but he uses it in cases in which it could hardly be expected to be successful. Sometimes the ligature does not cut completely through and must be tightened, or the operation completed by the knife; and rarely the sinus refuses to heal after the ligature has cut through. The ligature should, of course, be soaked in strong corrosive before introduction.

The most serious objection to it is in choosing appropriate cases, for the simplest fistulæ are often found upon close investigation to possess unexpected diverticula.

OPERATIVE.

The choice in operative treatment is practically limited to two methods:

1st.—Free incision, with granulation from the depth of the wound to the surface.

2d.—Removal of the fistulous tract by dissection and uniting the wound by sutures to secure healing by first intention.

The second method may be modified in some cases by curretting instead of dissection.

These methods may be briefly described as Incision and Excision.

INCISION.

Treeves says of this operation: "To Percival Pott is due the credit of the present method of operating. It was a common practice in his time to excise the entire sinus, and it is still common to hear the uneducated classes speak of having a fistula 'cut out.'"

In preparation for any operation on fistula the patient's bowels should be moved by cathartics, preferably saline, on the day preceding the operation, and by enema on the morning of the operation, and, if possible, not more than two hours before ether is administered. The diet for a day or two preceding should be exclusively meat broths. The position of the patient on the table may be either that of dorsal lithotomy, or on the side on which the main opening of the fistula is situated, with the knees flexed sharply on the abdomen. Mechanical cleanliness must be encouraged by shaving, and antisepsis rather than asepsis sought for. So far as possible fistulæ should not be operated upon while acutely inflamed.

The sphincter must always be dilated fully, both to facilitate the discovery of the internal opening and to hasten healing. The fistula, or if there be more than one, the largest of the external openings, is then investigated with a fine probe, particular attention being directed towards the discovery of branches or blind pockets. The opening into the bowel is often difficult to find, and it is the rule rather than the exception to find that the tip of the probe can be made to travel up and down the rectal wall for some little distance without perforating it. The finger of the unemployed hand is now introduced into the anus and the

orifice sought for. It is better not to force the tip of the probe through the mucous membrane if this can be avoided. It is advisable first to slit up the sinus from the outside a little at a time, with knife or scissors, in the hope of finding the inner opening as the operation progresses. The more carefully and thoroughly the incision is carried out, the better will be the chance of rapid and complete healing. Granulations or thickened sinus walls must be thoroughly removed by knife or curette, and small pus pockets or divertucula cleaned and scraped. The external sphincter may be freely incised without hesitation, but some care must be exercised in cutting the internal sphincter. It is desirable to leave part of its fibres intact, if this be possible; if not, it is absolutely necessary to cut through it at right angles, not obliquely, and it must never be incised in more than one place on pain of certain incontinence. Particular care must also be taken to avoid cutting the sphincters anteriorly in women, at the point where the fibres decussate, and are continued forward on the sides of the vagina.

The simplicity of the operation, in the average case, tends to make the operator less careful in its execution. As the result depends essentially upon its thoroughness, too much emphasis cannot be placed upon the necessity of discovering and laying open all branches and diverticula, however short they may be. This can only be done by examining carefully the floor and walls of the sinus progressively.

When the internal opening is well above the upper sphincter, three methods may be considered. The sphincter may be cleanly incised at right angles and left to granulate, or it may be incised and held together by a deep suture, or the elastic ligature may be introduced, as suggested by Allingham, at the bottom of an incision which reaches to the lower margin of the sphincter.

All bleeding should be stopped as far as possible by tem-

porary packing. In superficial fistulæ it is rarely necessary to tie vessels if the snap forcep be allowed to remain on them for a few minutes. After determining that the floor and walls of the wound are thoroughly cleansed, it should be packed, not too snugly, with a thin layer of iodoform gauze, a pad and T bandage applied. Some writers doubt the desirability of a suppository, but in an operation of any considerable extent it is better to insert it as a matter of precaution. A quarter grain morphine suppository is sufficient.

Horse-shoe fistulæ should be thoroughly opened, but should be incised into the rectum in only one place, that opposite the larger opening if two exist. If there are multiple openings externally, paths of communication between them must be sought for, and can usually be found; they should then be opened from one to another and finally, in one place, into the rectum. In some cases the openings are so numerous, and the tracts so deep, that it is very advisable to do the operations at two sittings, attacking the deeper portions first and simply dilating the other orifices. Much ingenuity has been exercised in determining the most advantageous methods of making the incisions between the various orifices, but cases vary so much that no general rule more than the above can be laid down.

The fistulæ which are at once the most dangerous and most difficult, are those which perforate the levator ani muscle and penetrate the subperitoneal space in the pelvis. To open these thoroughly demands a very deep and often bloody incision, but unless opened thoroughly the operation is ineffectual, for the levator ani closes down and retains the discharge above, tending to the formation of the so-called hour-glass fistula. If the fistula is in the usual position, posterior to the anus, there is much less danger of wounding the peritoneum. If it is anterior, however, this possibility must be carefully borne in mind. The opening

in the lavator ani may be stretched with Bigelow's dilator advantageously, and the packing must be inserted to the bottom. Old, deep fistulæ have been found to lead in all directions above the levator ani muscle and triangular ligament, and at times perforate the bladder, rectum or vagina.

As a rule the dressing should be changed on the second day after the operation, and each day after that. Thorough cleansing is essential, and it is best to use peroxide of hydrogen, permanganate of potash or corrosive sublimate. The packing should be carefully introduced to the bottom of the wound, and in small quantity. Care should be taken not to allow pocketing of the discharge, nor to interfere with the granulation by too vigorous dressings. The bowels should not be moved before the fourth or fifth day, and an enema of warm sweet oil ʒ iv. should be given and retained for one or two hours to soften the fæces, before the soapsuds enema which is intended to clean out the rectum. The diet after, as before, should be exclusively animal broths, for at least four or five days, since these produce least fæcal mass. The patient should lie preferably on the side opposite the fistula.

The after treatment is, in a majority of cases, at least as important as the operation. If good results are desired, the after treatment must be carried out by a competent assistant who understands its indications. The patients should be kept either in bed or lying down while there is a granulating area of any considerable extent, as the motions of walking are not conducive to healing. In packing the wound, iodoform gauze has given the greatest satisfaction.

The duration of the granulating process varies extremely. It is rarely less than three weeks, except in the most superficial cases, and often reaches three months and more. It is especially long in the cases perforating the levator ani, and in cases originating from necrosis of the coccyx, or

from the disintegration of pelvic glands. The character of the operation is so slight that the patient is often unprepared for the length of the monotonous convalescence. Of the 100 hospital cases recently operated in the Boston City Hospital the duration of the stay in the hospital averaged a little more than four weeks, the extremes being one and fifteen weeks. These cases were all discharged to the out-patient department, where they were under treatment at least two weeks on an average.

Whenever the internal sphincter is involved the patient must be expressly warned beforehand of the possibility of incontinence. Rarely is it true, of solid fæces, but often of gas or liquids; and not unfrequently this is a permanent condition. An insufficient sphincter, for which the owner is unprepared, is a memento of the operation which is not relished by either patient or surgeon, and is a poor exchange for a fistula which may have been but a slight annoyance.

EXCISION.

In order to avoid the slow granulation of a deep wound, American surgeons began to sew up certain cases of fistula, with the hope of shortening convalescence. In 1886 Dr. Smith published one of the earliest papers upon the subject. As surgery advances it is interesting to note that we are returning in a limited measure to the class of operation which is said to have been in vogue before the time of Percival Pott. The difference is, that at present fistulæ are not sewed up indiscriminately after operation, but the cases for excision are carefully chosen, and the value of cleanliness and antisepsis during and after the operation is fully recognized and appreciated.

Sinuses in various parts of the body have been excised and sutured for years, and there is no good reason why favorable cases in the ischio-rectal fossa should not be similarily treated. The essentials of the operation are that it

shall be possible to remove the cause of the sinus, to convert it into a clean wound, and to keep it clean. If these conditions are obtained and maintained, the result will be the healing by first intention. The type of fistula therefore to which this method is applicable, is non-inflammatory fistulæ, of moderate extent, with few branches; and also blind internal fistulæ of all varieties. In one case the writer has sutured a horse-shoe fistula with excellent result. The fibrous walls must be removed, preferably by dissection, sometimes with the currette. Granulations or pockets must be cleaned out with curette or Pacquelin cautery; hemorrhage stopped, and the walls approximated by deep sutures. Silk is the material usually used. It is advisable to introduce each suture so that it encircles the wound and does not pass through its sides. For this purpose the so-called fish hook needle has been invented. A strong needle with a sharp curve is essential, a Hagadorn preferably. The sutures vary in number according to the length of the fistula and should be inserted at least as often as half-inch intervals. Sutures are removed in from three to six days; the dressing should be a wet corrosive pad, 1-3000. The pain following the operation is apt to be greater than in simple incision. If the case is not progressing favorably, heat and redness increase, with the signs of retained pus; the stitches are removed alternately, and even in these cases a considerable amount of union is often gained. It is sometimes advisable, especially in old fistulæ, to insert an iodoform bougie into the bottom of the wound, and sew the sides together around it.

In superficial fistula it is almost invariably successful. In deeper cases it sometimes succeeds unexpectedly. It has never found much favor among English operators—most of them dismissing it lightly—and one (Cribs) denouncing it as "opposed to every tradition of sound surgery." Such an opinion is interesting as an indication of

pathological conservatism, but is worthless otherwise. It would seem that the operation of excision for fistula will find a larger field in the future. Its obvious advantage is in the time gained in convalescence.

No matter what the method of treatment may be, a certain percentage of cases which seem simple enough, will be found to be either obstinate in healing, or upon investigation to have recurred after a short period of apparent cure. In tracing cases operated during the past four months the writer has discovered such an instance. The man was discharged cured, after a dissection and suturing of a rather extensive sinus, which healed remarkably well. Two months afterwards, he presented a slight occasional discharge from an opening too small to be easily discovered, but which was so insignificant when compared to the condition before operation, that it would have been ignored by the patient.

In obstinate cases, second and third operations are sometimes necessary. By continued operation and care, however, almost any fistula may be cured, unless it be a symptom of an advanced general tuberculosis, or in a patient very much debilitated, or very old.

The question of advisability of operating upon fistulæ in patients suffering from pulmonary tuberculosis has been discussed at great length by almost every writer upon the subject. And yet the necessity for such extended discussion is not easily apparent. Of the 100 cases alluded to in the City Hospital, only three had symptoms which were considered of sufficient importance to be called phthisis complicating fistula. These three were operated and healed readily, and were discharged nearly well in one, two and four weeks respectively. More recently another case was admitted for operation in which the general condition was so bad that no operation was deemed advisable. The patient died of phthisis within three weeks. These cases show the indications for operating on fistula in phthisis, and

they do not differ essentially from indications for any other operation in the same condition. Each case must be a law unto itself. If in the judgment of the surgeon the condition of the patient is good enough to withstand the operation, and if the benefit expected is greater than the discomfort attendant upon the operation, then the fistula should be operated. It is not a fact that such fistulæ refuse to heal. And when they are obstinate, the general condition, rather than the local etiology, is to blame. As a rule, a typical tubercular fistula is easily diagnosticated by its large ragged openings—thin walls, sanious discharge and unhealthy appearance. In such operations it is well to substitute chloroform for ether; to get the patient into the sun and fresh air as soon as possible afterwards, to push the nourishment and to try and improve the general condition in every way. Gant, in speaking of this subject, says that five per cent. of all phthisical cases have fistula, and twelve per cent. of all fistulæ have phthisis. So far as the writer has been able to discover from a rather rapid examination of records, Gant's percentages are higher than the average for this part of the country.

While it is certainly true that occasional cases may be cured by cleanliness, caustic, or simple packing, there are still only three methods which may be seriously considered in the treatment of fistula, and their importance and value rank in the order given:

1st. Incision and packing.
2d. Excision and Suture.
3d. Elastic ligature.

And in all of these methods, the after treatment is at least as important as the operation itself.

ARTICLE XXXVI.

GENERAL REMARKS ON GASTRIC DYSPEPSIA.

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OF BOSTON.

READ JUNE 8, 1897.

GENERAL REMARKS ON GASTRIC DYSPEPSIA.

Disturbances of the gastric digestion are perhaps among the most frequent of human ailments. When we consider the complicated processes of the gastric digestive act, the wonder is, not that there are so many disturbances but that from the work we expect the stomach to perform we are not many more of us dyspeptics.

I. ETIOLOGY OF THE DIGESTIVE DISTURBANCES.

Frequently disturbances of the gastric digestion are caused by pathological structural changes of the gastric walls, and by morbid forms, sizes and positions of the stomach. Improper food, bad habits in eating and drinking, irrational modes of life, and general disturbances of the most various kinds, are much more frequently causes of gastric disorders, however, than are diseases of the stomach.

1. To begin with, how we eat, quite independently of the choice of food, often lies at the bottom of functional gastric disturbances. Faulty preparation of the food in the mouth by insufficient mastication and insalivation paves the way for future trouble. Business men, physicians, artisans and others whose time is limited, frequently take in great haste large quantities of food which they wash down with hot or cold fluids. The work which the teeth and salivary glands could have performed, if they had been given the time for it, is expected of the stomach. For a time

this organ performs the exacting requirements made of it, but gradually it loses its power to do so and dyspepsia has its beginning.

2. Another great fault, and one which very frequently gives rise to digestive disorders, is, that the stomach is not allowed sufficient time to completely digest one meal before another is taken on top of it. The secretory power of the gastric gland-cells is limited, and they also require a certain period of rest in which to prepare anew from the blood plasma the store given up and exhausted by the digestive process. If this rest needed for regeneration is not afforded them a condition of exhaustion ensues, in which their secretion of gastric juice does not reach the necessary requirements, either in quantity or quality. Moreover the filling up again of a stomach not yet emptied leads to an overdistension of the gastric walls, which gradually may produce a relaxation of the latter unless an increased motility of the stomach pushes on the food more rapidly and earlier than common. In the latter case the intestine has imposed on it a labor which is often beyond its power of accomplishing if it must receive the chyme in an insufficiently prepared condition.

The excess of food over its needs is usually rejected without further trouble by infants, though not always. In the later years of childhood the motility of the stomach is so great, especially in active children, and in those always on the go and growing rapidly, that they can take great quantities of food at relatively short intervals without being disturbed by it. When we examine the stools of such a child we will frequently find that by no means all that has been eaten has been digested, and that in some cases in which undigested food is passed with the fæces, gastric and intestinal troubles also occur.

Vigorous, full grown, adults can make the stomach perform great work when they do severe labor and take much

exercise. But if they continue to take in the same amount of food when the mode of life has become sedentary, or from other reasons the bodily exercise has been given up, very soon repletion of the whole body ensues, accompanied by dyspeptic troubles.

As age advances the capabilities of the stomach, as of the other organs, diminishes; the need of new nutritive material is less, and the body is more easily satisfied. The digestion of the various meals requires more time than in younger years, and supplementary between-meals may be burdensome. Disturbances of the balance between bodily taking in through food and giving out through work manifest themselves very soon with age by disturbances of all kinds and in all organs, especially in those which perform the functions of digestion, assimilation and excretion. An aged person, especially, to keep in good health, requires the wisdom to recognize what is good for the body and what is bad for it, otherwise he is threatened with premature disease.

3. The choice of food, the composition of it, and the size of the meal taken at one sitting, naturally play an important part in the history of the development of digestive disturbances. Of itself an article of diet may be easily digestible; taken in too great quantities, poorly prepared, or in improper combination with other food, it may nevertheless upset the stomach. Milk, for example, and milk preparations, except perhaps whipped cream, which in the process of whipping takes up from the air enormous numbers of bacterial excitors of fermentation and decomposition, are generally accounted easy of digestion. But how often do we meet persons, not to mention infants, who cannot bear milk in any form or preparation, and who sicken with dyspepsia when, in spite of their aversion founded on instinct and experience, we get them to take it. There are also people who cannot bear eggs, and others who have an

idiosyncrasy against this or that article of food used in daily life. I will mention here lobsters, crabs, scollops, many fish and strawberries, which are highly esteemed by many people, yet in others give rise to urticaria with oftentimes very severe dyspeptic difficulties.

It is impossible to lay down general laws about the digestibility or otherwise of certain articles of food, for the digestibility of a food depends on the individual secretory and motor power of the stomach, which in the same individual is not always the same, but is subject to enormous changes. Merely to speak of the influence of surroundings, what does one not eat with impunity at a church fair, a Massachusetts Medical Society meeting, or a class reunion? Beaumont's table of digestibilities is interesting but can lay no claim to general application. Concerning digestibility, we may say the following in general: that food is as a rule digestible and acceptable, which, without disturbing the stomach, can be digested by the gastric juice, and in not too long a time can be passed into the intestines without burdening them.

4. The process of digestion, especially its duration, is frequently protracted by the injestion of too much or too cold fluid. As Fleiner* says, a drink of ice-cold beer can wholly stop the gastric peristalsis for a shorter or longer time and cause great discomfort or even dyspepsia of several days' duration. A bad custom is the drinking of too cold mineral water at meals, or one too rich in carbonic acid, so-called table water. The carbonic acid which is latent in the cold, when it gets into the stomach and is warmed, is rapidly set free and overdistends the stomach. A part of the carbonic acid escapes with belching, and brings with it air swallowed, or gas formed in the stomach; another part, however, gets into the intestine, and causes unpleasant conditions of flatulence. Often, to be sure, but

* Lehrbuch der Krankheiten der Verdanungsorgane, p. 114, 1896.

not always, the carbonic acid rouses the peristalsis of the intestine; at least, many people have a movement of the bowels soon after taking soda water or champagne.

Water-ices and ice-creams are refreshing substances, which are rather to be included among drinks than among foods. They usually arrive in the stomach in a fluid state but still so cold that not every stomach can bear them, especially when it is empty or when the body is in a heated state. Experience teaches us that the application of cold to the abdomen often rouses the peristalsis of the stomach and intestines and with this intention an icebag is sometimes applied. With a full and distended stomach, and cold champagne and ices usually come at the end of a large meal, taking such things may cause a more rapid emptying into the intestine. Nevertheless an ice is frequently badly borne because it pushes food not yet sufficiently prepared from the stomach into the intestine and thereby causes harm, and because the milk and fruit of which it is composed are not protected by the freezing process from the action of bacteria, and are therefore often already in a condition of decomposition which continues in the intestinal canal.

Children at meals usually take a very large quantity of water to wash down their food because their secretion of saliva seems to be insufficient for all their food, they also pass out much water by the lungs and skin; at least the more healthy ones and those who are constantly active do so. It is naturally difficult in a child to keep to the proper amount of liquid always, and it is very easy for the delicate organism of the child to be temporarily upset.

5. Adults, especially men, frequently supply the needs of the body for water by means of alcoholic drinks. The strong alcoholic liquors are detrimental to the digestive processes in the stomach, and are directly injurious to the mucous membranes of the throat, œsophagus, stomach and upper intestines where they are chiefly absorbed. This is

especially true of the customary glass of brandy or similar liquors taken after dinner. The chronic catarrh of the throat and stomach of spirit drinkers is ample proof of this statement. Nevertheless we cannot deny that certain gastric discomforts, which arise after taking food rich in fat, can be removed by taking a glass of liquor. It is well known that fat in the fluid condition of fat drops remains lying in the stomach a long time, and causes by its separated fat acids an unpleasant burning sensation. Physicists teach us, Quincke for example, that a relatively large surface covered with a thin layer of fat can be very easily freed from the latter by alcohol. One drop of alcohol put on an oiled glass plate is sufficient to completely clear up the layer over a large surface and free the same from oil. It is possible that a similar process takes place in the stomach, though we cannot prove it; while on the other hand it is a fact that alcohol causes a powerful flow of liquid into the stomach, which may have a cleansing and emptying action. We must not forget, however, that alcohol precipitates pepsin and thereby has a checking action on the gastric digestion. For this reason the pepsin wines which are in frequent use seem to be irrational, and are said by Dr. Pfaff, of the Pharmaceutical Laboratory of the Harvard Medical School, to be without exception wholly inactive.

Though we may strongly advise against the use of strong alcoholic drinks after meals, and the so-called stomach bitters before them, we cannot wholly condemn the use of milder alcoholic drinks, as for example light wines or beers. The taking by adults of a moderate quantity of wine or beer with dinner, better toward the end or after it, is not only harmless but frequently is of service. Fanatics on the alcohol question who in the place of wine or beer would have us drink coffee and tea, according to most experience, thereby prove more detrimental to the digestive, the circulatory and the nervous systems, than by allowing

the mild alcoholic drinks. In many persons coffee, and still more tea, rouses the nervous and muscular apparatus of the stomach to such a degree, that the chyme is driven too quickly and hence in an insufficiently prepared condition into the intestine and gives rise there to all kinds of dyspeptic disturbances, as great formation of gas, flatulence, peristaltic restlessness, increased peristalsis, diarrhœa and later relaxation of the intestine. The cardiac muscle, like the gastric and intestinal canal, is unduly excited, and not infrequently we observe after taking tea a long continued pulse-beat of one hundred and more.

6. The misuse of spices and succedanea as a cause of dyspepsia should be mentioned. The moderate addition of condiments to food has become necessary to most people through custom, and one may well say that the processes of digestion are hastened by condiments, in that they stimulate the secretory and motor functions of the stomach and often of the intestine as well. Nevertheless all condiments are irritants. In tardy and insufficient action, atony, of the digestive organs, the use of these irritants may be proper under certain circumstances; but healthy organs scarcely need them and they are directly harmful to excitable individuals, not only to their digestive organs, but also to the entire system, and particularly the nervous system. The continuous stimulation of the gastric nerves by highly spiced food leads to overstimulation and gradually to blunting and weakening of these nerves. Highly seasoned food, as of hotels and clubs, by stimulating the digestive organs to excessive activity, may be the starting point of immoderate eating and drinking, which may in turn be followed by diseases of the most diverse kinds.

Most of the patented meat- and albumen-surrogates found in hospitals and private houses act as stimulants, like condiments, and without calling forth the agreeable sensation of satisfaction. Personally I use the pharma-

ceutical fluid, or solid substitutes for meats, only exceptionally when the products of the kitchen are not accessible. The use of medicines in diseases of the digestive organs demands great care also, for the number of useful and necessary medicaments is not very large.

7. Behavior after eating. If now in the choice, preparation and eating of food we must follow the laws of health, so must we also pursue a certain course after eating or we shall suffer troubles. According to a Latin proverb quoted by Fleiner, "post cœnam stabis aut mille passum meabis," we should take a short walk after eating. An old German saying, cited by Schüle, klinische Beiträge zur Physiologie des Magens. Berliner Klinische Wochenschrift, 1895, Nr. 50., is "Fliehe den Schlaf nach dem Essen." On the other hand we see the household pets go to sleep after being fed, if they are permitted to do so. A great desire for repose comes over most people after the chief meal of the day, which has its explanation in this, that the stomach requires so much blood for its functions that but relatively little is left over for those of the other organs. At all events, great headwork is well-nigh impossible after an abundant meal, and if such work is forced it is at the expense of the digestion which becomes retarded. Also great muscular exercise after meals is not well borne, as was definitely settled by experiments of Dr. Cohn, L'Abeille Medicale, Nov. 19, 1888, and we frequently find dyspepsia among people of every age, who must walk in a hurry a long distance after eating to get to their work, whether it be school, work-shop or counting-room. The emptying of the stomach in such persons is interfered with mechanically, and also the muscular exercise takes away a good portion of the blood from the stomach to supply the muscles, and a diminished portion is left to help secrete gastric juice. The stomach for this reason remains too long burdened with food, the gastric walls relax under the

too protracted pressure of this load, and there follows as a result the atonic disturbances of digestion.

With physical rest after eating, on the other hand, the secretion of gastric juice and the motility of the stomach increase; and in a comfortable dorsal or right lateral decubitus, the stomach can best push on the fluids it has received, and the contents which have become liquified, into the intestine. Here the fluids are very rapidly absorbed and may cause a very considerable increase in the blood pressure. In corpulent people of apoplectic habit this rapid rise of blood pressure is often very serious and may prove fatal. An apoplectic attack which comes on during sleep after a meal is not to be attributed to the sleep, but to this increased blood pressure because of too much food and drink.

II. GASTRIC DISTURBANCES AS ACCOMPANIMENTS OF GENERAL DISEASES.

The stomach takes a more or less active part in the diseases and disturbances which affect the rest of the body. It shows this most in the diseased processes of the parts of the digestive tract, lying above and below it and in direct connection with it. Diseases of the neighboring organs, hepatic, splenic and pancreatic tumors, abdominal tumors, collections of fluid in the peritoneum or pleura, may mechanically interfere with the performance of its motor functions by crowding it or displacing its ostia, or by causing changes of shape or position, and thereby call forth dyspeptic conditions. Other disturbances, local or general, draw the stomach into sympathy through the medium of the nervous system, or the blood. Among the changes of the blood the ones we know most about are chlorosis and anæmia, and all considerable degrees of these disturbances are accompanied by dyspeptic conditions. Anæmic dyspepsia, as Fleiner calls it, is one of the most frequent of conditions affecting young girls and women, not sparing children and

men even. It is very probable that chlorosis, like many other conditions of abnormal composition of the blood, arises from anomalies of nutrition and digestion; the anæmic conditions on the other hand arise from losses of blood of all kinds. An especially frequent one is the profuse menorrhagia, which is seen in women after a single severe pregnancy, or after several pregnancies which have rapidly followed each other. It is also frequent in uterine misplacements and inflammations.

In order to understand how dyspeptic conditions may arise in poor-blooded people, it should be remembered that all glandular secretions come from the blood and are only formed out of it by the specific activity of the secreting epithelial cells. Claude Bernard's experiment on the submaxillary gland best demonstrates this fact. On irritation of the facial nerve at its root the vessels of the gland become dilated, the capillaries become so distended with increase of blood pressure that the pulsation of the arteries is propagated even into the veins, and according to Landois more than four times as much blood as is normally the case flows back out of the vein. The small store of nutritive material is naturally soon exhausted from a small amount of blood, and thus it happens that too little and too feeble gastric juice is secreted by the stomach of poor-blooded people. It is probable also that the same thing is the fact with the saliva and the intestinal juice. The dyspepsia of anæmics depends in the first place on a secretory weakness of the stomach. But poor-blooded people have also weak muscles, and their insufficiently or abnormally nourished nerves have an increased or diminished irritability. The small feeble gastric secretion of such people therefore may be coupled with motor and nervous disturbances of all kinds. With the improvement of the composition and quantity of the blood, and the stopping of the sources of loss of the same, these forms of dyspepsia are cured.

In like manner as in anæmia the functions of the stomach, especially the secretion of gastric juice, may be disturbed by the influence of cachectic conditions, cachectic dyspepsia; and of acute or chronic fever, febrile dyspepsia. Presumably in the dyspepsias of the latter class, toxic conditions, toxic dyspepsia, play a greater rôle than high temperature; at least the gastric disturbances considerably outlast the ferbrile period, in for example infectious anginas and particularly diphtheria. Often weeks, and months even pass after an attack of diphtheria, before the stomach completely recovers.

There are no pathological appearances to be expected in these forms of dyspepsia mentioned except perhaps in the anæmic ones, since they are chiefly functional disturbances without organic changes of the gastric wall.

III. SYMPTOMS OF DYSPEPSIA.

Digestive disturbances usually accompany most of the gastric diseases dependent on pathological changes of structure. They also occur in the morbid shapes and positions of the stomach, and, as might be inferred by what has preceded, they appear as purely functional disturbances of great variety, affecting either the stomach alone or the whole organism as well. They give rise to troubles of a very subjective character and often of markedly individual type. Naturally a negative local or general examination is by no means sufficient to refer the troubles experienced by a patient to purely functional disturbances, and to exclude an organic change, that is a true disease of the stomach; for even the most severe diseases of the stomach, as ulcers and even cancers, may often run their course without any external appearances.

According to their origin and course we may divide dyspeptic conditions into the two groups, acute and chronic. Generally, but not always, the troubles which come from

acute dyspepsia are more severe than those from the chronic form. Nevertheless in the latter there are often transient exacerbations of the digestive disturbances and accompanying troubles which take on an acute character.

1. Acute dyspepsia begins as indigestion, following a meal which does not set well, an error in diet, an excess in eating or in drinking, and shows itself as a general sense of discomfort and an unpleasant feeling of pressure and fullness in the gastric region. The food lies heavy on the stomach as if it were not digested and passed on. Rapidly or gradually the discomfort increases, the stomach becomes distended, and nausea comes on accompanied by increased secretion of saliva. A feeling of burning in the stomach and behind the sternum increases the sense of thirst and causes repeated swallowing of saliva or the drinking of water, which allays the burning for a time. The patient temporarily feels relieved by eructations which may occur spontaneously or may follow a drink of water. But the trouble soon returns and increases in severity and may develop into intense crampy pains. Finally vomiting ensues with relief. Some people vomit with the greatest ease, especially children and adult males, while many women and girls can either not vomit at all or only with the greatest difficulty, the stomach being low down and forming a loop, and the œsophagus being long and flattened. Where vomiting speedily follows or can be produced voluntarily either by suggestion or by thrusting the finger down the throat, the indigestion is soon over, if the stomach can completely throw up its contents. Many people, not alone children, can immediately eat again after the stomach has been thus relieved of its burden, but they are more usually able to continue to drink liquid without great harm. A sound stomach endures much and will suffer long-continued abuse before it becomes disordered, and though it is usually considered to be a fortunate thing to possess a good stomach, it is an old observation

that those who have to be careful of their digestion are the ones who live the longest.

The troubles last longer and often increase in intensity in people who either cannot vomit or can do so only after the course of some hours or the next day. In these cases, a greater or less considerable portion of the gastric contents, which is harmful through imperfect digestion and perhaps abnormal decomposition, gets into the intestine and causes great gaseous distension, colicky pain, increased peristalsis and diarrhœa. It is noteworthy that where vomiting is relatively late the vomitus often consists chiefly of solid particles of food, which can be recognized. The stomach in such cases having pushed forward into the intestine only the fluid drunk and the food which has become liquid. We see cases also where all the contents, both solid and fluid, have remained in the stomach with a considerable additional amount of fluid secreted by the gastric mucous membrane. These are especially the cases which are accompanied by great pain and serious general symptoms, as collapse and cramps; which complications are mostly due to reflex processes set up by the great distension of the stomach, or by the sudden relaxation of an over-distended gastric wall from the vomiting of large quantities.* Fleiner† considers that in the over-distended stomach there is a spastic or passive pyloric closure caused by mechanical pressure, more rarely that the downward traction of the overloaded stomach causes a kink in the duodenum. These conditions may be caused by the tight lacing of corsets favored by dancing, sports, or other considerable muscular exercise.

2. In chronic dyspepsia, the gastric symptoms are not so prominent as in acute dyspepsia; and what symptoms are present are mingled with general disturbances, which may be either the causes or results of the gastric dyspepsia.

* Fleiner Archiv der Verdauungs Krankheiten, 1895. Band I., s. 243.
† Lehrbuch der Krankheiten der Verdauungs organe, 1896. s. 151.

Intestinal disorders are also combined with chronic dyspepsia. As a result, the whole process of digestion, from the taking in of food to the time of fæcal discharge, is associated with unpleasant sensations, sometimes more, sometimes less, according to the kind of food and drink taken. The sufferings which dyspeptics experience seem to increase when they are dwelt on even when those affected are not hypochondriacs, so that it is very difficult to provide for them in a household. Sometimes one kind of food, sometimes another, or its mode of preparation, is thought to be at fault. The result is that the diet list of most chronic dyspeptics gets to be smaller and smaller from omissions, and there follows a one-sided diet or insufficient taking of food and consequent loss of flesh. We sometimes see, however, well nourished and even fat dyspeptics who eat and drink too much and too good food and have contracted bad habits of all kinds to which their gastric troubles are attributable.

With the loss of weight, strength, and quantity of blood there is also a dimunition of the gastric powers, the stomach becomes more sensitive and irritable, and digestive disturbances increase so that, at the first examination of such patients, one might well think there was a severe or even fatal disease. And yet frequently it only needs a proper diet and a rational arrangement of their mode of life to change, in the course of a few weeks or months, what was thought to be a severe condition of disease into one of perfect health.

The appetite in chronic dyspepsia is frequently, though not always, disturbed. It is oftener more from fear of the consequences of indulgence than from lack of appetite that too little is eaten. The tongue may be perfectly clean, though it is often coated, and many complain of a nasty taste in the mouth. There is very frequently chronic pharyngeal catarrh, especially in smokers and those who take

liquors after eating to lessen their discomforts or strong wines to increase their strength. Hawking, retching and tendency to vomit in the morning, in such cases, is oftener attributable to the pharyngeal catarrh than to the gastric disturbances.

Complaints about the stomach in dyspeptics are tolerably uniform. Feeling of fulness, weight, uncomfortable pressure in the region of the stomach, especially in the pit of the stomach, come on during eating or soon after, and increase for a time and then gradually diminish again. At the same time the pressure of the clothing is so burdensome that it must be loosened over the epigastrium; still a sense of stricture remains, there is frequently palpitation, intermittent or irregular pulse, anxiety sometimes coupled with feeling of heat in the head and coldness of the hands and feet. If there is belching, relief follows; and many dyspeptics try to bring on eructations as soon and as often as possible by contracting the diaphragm and abdominal muscles. Such eructations may occur during the entire duration of digestion; they often cease sometime after eating, and again they keep up even when the stomach is empty. Such patients usually say that this or that article of food keeps rising, and they claim to have this or that sense of taste with the eructations. It is exceptional, however, for dyspeptics without gastric dilation, cancer, or ulcer to belch anything but an odorless gas. Frequently with the eructed gases, fluid, more rarely solid, gastric contents come up into the mouth, from which they are usually swallowed again or less frequently spit out.

Dyspeptics complain most of pyrosis or heartburn, that is, a burning sensation in the epigastrium, which may reach up behind the sternum to the throat or even to the mouth. It is generally considered that here we have to do with the rising of acid gastric contents and an increased secretion of acid in the stomach, but Einhorn* says that the sensation

* Diseases of the Stomach, New York, 1896, page 418.

can exist even without the presence of an acid, and McNaught has called attention to the fact that symptoms of pyrosis may be present with the normal quantity of acid. Ewald* and Leube† regard pyrosis as a kind of motor neurosis, especially a condition of irritation of the motor centres.

In simple dyspepsias, as a rule, vomiting does not occur if there are no accidental exacerbations of the old trouble through dietetic errors. The same is true of severe pain. On the other hand most gastric dyspepsias are accompanied by intestinal disturbances which are often quite painful. Even during a meal or soon after it, many people with stomach trouble experience a distension of the intestines and a restless activity of the same, which are indicated by a rolling, clucking, quacking sound which may be heard even at a distance. Either the fluid and fermenting gastric contents get too soon into the intestine and are moved onward, or the energetic peristalsis which is roused in the stomach by being filled with food and drink, is imparted to the intestine. In many patients a desire to defecate comes on soon after eating, which may be several times repeated, and an abundance of stinking gas may also be passed at the same time. Such patients are often much troubled in thinking that it is the food just taken which has passed through them, which, of course, is not true. Wholesome advice in such cases always is, not to eat so fast and not to eat so much; for any one who regularly has two or three stools a day without at the same time emaciating eats too much for his needs.

In sedentary people with a relaxed colon and abdomen a large and hasty meal may cause rapid accumulation of gas in the intestine at the hypochondria and epigastrium close under the stomach, giving rise to sharp colicky pain, often wrongly attributed to the stomach or to the liver or gall

* Klinik der Verdauungs Krankheiten, s. 425.
† Specielle Diagnose der inneren Krankheiten, II., s. 240.

bladder. The intestinal canal in such cases need not be diseased at all.

In contrast to these cases another series of dyspeptics complain of constipation. This arises in many instances from the fear of gastric discomfort, leading them to eat too little, and moreover to partake of a food which has little refuse matter, as meat and eggs. By the introduction of boiled farinaceous foods and vegetables into their dietary, the stools are frequently regulated without any further trouble.

Real diarrhœa is found in dyspeptics, as a rule, only when the intestine, especially the colon, is affected together with the stomach.

IV. DIAGNOSIS AND APPLICATION OF THERAPEUTIC INDICATIONS.

In order to gain a knowledge of the processes which take place in the stomach, it is necessary in the first place, since external characteristic conditions in most dyspeptic cases are not to be found, to carefully compare the history of the patient with the known physiology of digestion and pathology. We should first try to draw diagnostic conclusions from the history of the patient which justify our therapeutic attempts before we use the stomach-tube and make analyses of the gastric contents. These latter should only be used when nothing more can be accomplished without them, and we are convinced of the necessity of their use. We are glad if we can help our patients without the need of the stomach-tube; on the other had we should never omit its use where we can thereby either avoid harm or may reasonably expect benefit to result.

It is especially the symptoms of eructation, formation of acid and pain in gastric dyspepsia, which are often very difficult to interpret.

In eructations, as a rule, only gas comes from the stom-

ach, more rarely with the gas portions of the solid or fluid gastric contents come up also. The question now arises what kind of gas is this, and what is its source? By many it is too frequently regarded as the product of abnormal fermentation processes, carbonic acid, hydrogen, and so forth. The development of carbonic acid in the stomach occurs in alcoholic fermentation through yeast spores, and of carbonic acid and hydrogen in acetic fermentation, but almost always only in very severe gastric diseases accompanied by motor insufficiency. In such cases the development of an inflammable gas is no great rarity. In the ordinary functional dyspepsias gas fermentation is relatively rare. For this reason creosote, naphthol and other modern antiferments are seldom of any special good. Hoppe-Seyler says that the gas which is removed from the stomach by eructation is for the most part only atmospheric air. In many foods and drinks much air is held, and by this means gets into the stomach, where it remains a longer or shorter time. In mineral water, which is often irrationally taken with food, much air and carbonic acid is often contained, which thus gets into the gastro-intestinal tract. Moreover, many dyspeptics swallow considerable air with the saliva.

Increased production of acid in the stomach, and the sensation of heartburn dependent on it, may have a twofold cause: either increased secretion of hydrochloric acid, hydrochloric hyperacidity of the gastric juice, or increased formation of organic acids in the stomach. In the first case we have either increased irritability of the nerves of secretion, or gastric ulcer and the gastric contents irritating the ends of the secretory nerves exposed in the base of the ulcer.

The increased formation of organic acids in the stomach depends on abnormal fermentation during gastric digestion. Perfectly healthy persons, who produce a good gastric juice, and whose gastric motility is sufficient, may at times be

plagued by heartburn caused by organic acids. In such cases something eaten is at fault; the food has been too fat, as fried food, meat, or cereals, perhaps mayonaise dressing, or food and drink undergoing the acid fermentation, whipped cream, sour cream, new beer or wine and so forth. There is reason to believe that here the fat and fat acids remaining in the stomach give rise to the trouble, and as already mentioned, a drink of spirits, as brandy or whiskey, will probably clear out the stomach the quickest, but it is to be very seldom employed for this purpose for obvious reasons. The acids which do not come from fats are soonest removed from the stomach by a glass of simple water, weak alkaline water, or a cup of weak tea.

In patients suffering from chronic dyspepsia a hyperacidity of the gastric juice due to organic acids may develop even when there has been no dietetic error, as the result of atony, the stomach not emptying itself soon enough, and the food therefore remaining too long in the organ. Here the ferment organisms already present, or taken in with the food and saliva, have time to develop their activity. The fermentation process, moreover, is favored by a weak gastric juice, that is, one poor in free hydrochloric acid, as it does not sufficiently inhibit the pathological fermentations. If, however, there is good or increased gastric motility, such patients do not complain of heartburn but of intestinal discomfort; so that instead of a gastric trouble one thinks he has to deal with an intestinal difficulty.

How can we then in any given case with some probability determine, without chemical examination of the gastric juice, whether the pyrosis comes from hydrochloric or organic acids?

The burning caused by hydrochloric is much more severe than that caused by organic acid. It frequently increases to intense pain of a cramp-like or neuralgic character, which only ceases with the act of vomiting. Moreover, the burn-

ing, pain and vomiting often come on directly after eating, frequently even when the stomach is empty, and sometimes during the night. The taking of milk and egg sometimes lessens the trouble. There is often desire to take food at frequent intervals. Oftener patients with such symptoms suffer from constipation than from diarrhœa or flatulence.

On the other hand the heartburn caused by organic acids is much more frequent than from hydrochloric acid, and as a rule appears sometime after a meal. It begins slowly and increases gradually without reaching great intensity or causing great pain. It is more troublesome than painful. Desire to take food is absent so long as pyrosis is present, but not because small amounts of food between meals really increase the heartburn. Occasionally a little sour-tasting gastric contents rises into the throat with eructations, but there is no real vomiting except exceptionally after great dietetic errors. On the other hand there is frequently with the heartburn a marked gaseous distension of the intestine which may lead to severe colicky pain, if the intestinal peristalsis is slow as so frequently happens. This latter condition then often gives rise to constipation, sometimes however there is tendency to diarrhœa or at least irregularity of the stools. Six or seven hours after the chief meal this sort of heartburn usually ceases and the feeling of hunger returns again. With an empty stomach in the night for example, or early in the morning before food, heartburn caused by organic acid never occurs in contradistinction to that from excess of hydrochloric acid, unless the stomach is insufficient in motility.

External examination shows such stomachs as a rule to be relaxed, at least succussion sounds may be obtained in them several hours after the last meal.

Over-abundant secretion of hydrochloric acid is to be treated as in gastric ulcer and neuroses of secretion. A tumbler of cool water should be given early in the morning

on an empty stomach. The diet should be restricted to milk, eggs, white meat, easily digested cereals, and vegetables and fruit. Usually more than the three stated meals are indicated. Symptomatically alkaline spring waters, lime water and calcined magnesia can be used to neutralize the acid. Of the former, Fachinger, Bilin, Vichy and Vals are much used in Germany, a tumblerful of either of the first two, and a wineglass of either of the last two, a quarter of an hour before each ordinary meal. Alcoholic drinks should usually be interdicted and all condiments. Jaworski, Ewald and Hyem claim that sulphate of sodium has the property of reducing the rate of secretion of hydrochloric acid, and the latter author claims that the use of Carlsbad water may lead to the total disappearance of hydrochloric acid. He gives a small quantity of sulphate of sodium or of Vichy water every morning before breakfast. The chief thing is to reduce to a minimum the direct or indirect stimulation of the gastric mucous membrane. An objection which has been urged to the continued use of bi-carbonate of sodium is, that it becomes chloride of sodium in the stomach which is a great excitant to the secretion of hydrochloric acid.

In severe cases the stomach should be systematically washed out before breakfast as well.

The treatment in the increased production of the organic acids is that of chronic gastric catarrh and gastric atony. As there is usually much secretion of mucus this is to be removed either naturally by giving water to drink early in the morning, or artificially by washing it out by means of the stomach tube. By the former or natural method the mucus is washed on into the intestine where under certain circumstances it can cause harm. By the latter or artificial means the mucus is directly discharged from the body. In all severe cases the artificial means is preferable to the natural because it is more thorough. The natural means is indicated

in slight cases or in the subsequent treatment of severe ones already benefited and nearly cured by the washing process. Since mucus is not readily soluble in ordinary water we usually add an alkali to it when we wash out with the stomach tube. Experience teaches that a mixture of table salt and soda in the proportion of two to one is the best. The ordinary formula is chloride of sodium two parts, carbonate of sodium one part, of this a heaping teaspoonful is added to two or three quarts of water at 90.5° Fahr.

For drinking waters there are many to choose from, for all the alkaline-saline, and saline waters are proper to use. Among these are Kalsbad, Marienbad, Bilin, Saratoga Hawthorne Spring, Kissingen, Hamburg, Soden and Saratoga Congress. A diet of milk, different cereals with milk and eggs, gruels and purees is best to begin with and is gradualllly increased.

Pain in the stomach when there is no decided structural change of the gastric wall as hemorrhagic erosion, ulcer or carcinoma present is most frequently caused by spastic contractures at the gastric ostia or by excessive distension of the stomach. In spasm of the cardia, true cardialgia, the location of the severest pain is behind the tip of the xyphoid cartilage in the pit of the stomach, and even higher up in the chest between the sternum and vertebræ, corresponding to the position of the œsophagus. Since frequently no distinct cause can be found for this pain, and because it occurs suddenly and unexpectedly, and after a shorter or longer time disappears just as suddenly usually after a few eructations, it is for the most part regarded as nervous.

Nevertheless such a cardialgia may very frequently be referred to purely mechanical causes. G. von Swieten maintained the opinion, that in rapid over-distension of the stomach the orifices of the same were convulsively closed tight, and that such a closure could as well be the result as the cause of a painful gastric cramp. Furthermore, Fleiner*

* Krankheiten der Verdauungsorgane, s. 158.

calls attention to a bulging of the œsophagus, which is frequently found partly above and partly below the diaphragm, which is bounded above and below by a narrowing, and which he calls a vormagen or antrum cardiacum. Gases, sometimes also acid gastric contents, rising from the stomach or coming from the œsophagus, particles of food swallowed, caught in such an antrum cardiacum, become incarcerated and then give rise to troublesome pressure under the sternum, which usually disappears after one or two belchings.

Fleiner also says that the escape of gas through the mouth may be rendered difficult, in a purely mechanical way, without either spasm of the cardia or an antrum cardiacum, by the powerful traction on the œsophagus of a downward displaced and well loaded stomach, or by a kink in the œsophagus when the fundus is pushed up or displaced to one side.

Spasms of the pylorus, like spasm of the cardia, may be the result of undue distension of the stomach. It is however more often the cause of distension, because the sphincter of the pylorus can wholly close the opening and stop the exit of the gastric contents into the intestine. Also solid food may be temporarily held fast by it at the moment of its passage through the pylorus. Spasm of the pylorus is stronger than that of the cardia because the muscle is here in greater development.

Trousseau was the first to claim that half the so-called gastralgias were located in the intestine, namely in the two flexures of the colon, more seldom in the tranverse colon.

We have now seen that, with the exception of the pains dependent on great structural changes of the gastric wall, stomach pains and cramps come only from hindrance of the movements of the gastric contents either up or down. The important rule for the treatment of stomach and intestinal diseases to be deduced from this is that we should use opiates as seldom as possible, because morphia and opium paralyze

the movements of the gastric and intestinal muscles for a long time. It is true that a subcutaneous injection of morphia acts rapidly and surely in a gastric cramp, but it only gives temporary relief, it is not curative. The pain disappears quickly, the spasm relaxes, the muscle ceases to contract, but not alone where there was spastic contraction before but also in the whole stomach. The relaxed paralyzed gastric wall yields to the weight of the ingested contents and dilates, in which condition it is less able to drive out its contents than before. When the action of the opiate has ceased the stomach resumes its work under more unfavorable conditions than when it was interrupted. For this reason we must forbid all chronic dyspeptics the use of opiates if we wish to cure them, and restrict their employment to incurable and inoperable cases as in carcinoma.

Almost all the medicaments used for gastric pain, especially cramp, have in view the facilitating of the emptying of the stomach into the intestine. And the household measures except hot compresses to the abdomen, such as tea, black coffee, chamomile, peppermint, balm, valerian teas and the like arouse peristalsis, open the pylorus and favor the emptying of the gastric contents into the intestine.

To find the relation or dependence of dyspeptic conditions on other local diseases or general disturbances we should not content ourselves with simply inspecting the tongue, and examining the stomach, and perhaps the other abdominal organs, but we should make a complete examination of the patient all over. The lungs especially should be thoroughly examined since very frequently the beginning of phthisis is concealed by gastric disturbances which spring to the fore. We should also never neglect to examine the urine at least for albumin and sugar. And sometimes the excretion of large amounts of uric acid will give points on many improper habits of diet and modes of life, or the finding of aceton or increased production of indican.

The blood should also be examined, especially as to its quantity of hæmoglobin, with Fleischl's or other fit apparatus once a week, and the patient should also be weighed. If by arranging the diet, changing the mode of life, ordering times of work and rest, resting after meals in anæmic dyspepsias, we do not increase the hæmoglobin beyond a certain limit, we must use mild preparations of iron as ferratin or iron peptonates in addition. A change to the mountains or seaside is often beneficial. If there be too great a lost of blood at the menstrual period sometimes fluid extract of hydrastis canadensis in medium doses three times a day continuously, and of viburnum prunifolium twice a day twenty to twenty-five drops, only during menstruation, prove of service. If these simple means do not suffice Czerny and also Fleiner advise the use of a tampon applied twelve to twenty-four hours after menstruation has begun, or in some cases directly at the beginning of the process in the ordinary manner. The tampon is allowed to remain in place twenty-four hours and is then removed, and after emptying the bladder and washing out the vagina it is re-applied a second time. Often a single tamponing suffices, though at times a third, fourth, or even fifth repetition may be needed. Of course this procedure has to be repeated at the next menstrual epoch. As the patient increases in strength the tendency to undue hemorrhage diminishes and finally ceases.

ARTICLE XXXVII.

FOOD NOSTRUMS.

By CHARLES HARRINGTON, M.D.
OF BOSTON.

READ JUNE 8, 1897.

FOOD NOSTRUMS.

THE inventors and promoters of quack medicines have always shown the greatest commercial enterprise in pushing their wares, persuading the people that though feeling well they really are sick and in need of blood-purifiers, health restorers, spring medicines, kidney and liver cures and such; but in spite of their efforts, they have been unable to invade, as successfully as they would like, the ranks of the more intelligent, who hold quack medicines in deserved contempt. But this latter field is now being tilled by another class with enormous success, and many who would scorn to use a secret medicine are easy prey to the vendors of so-called health foods, which in various forms and under fancy scientific-appearing names, are recommended for all ages from the suckling babe to the tottering nonogenarian. We have substitutes for mother's milk of greater nourishing qualities than the food given by nature; blood-making preparations for the growing youth; foods of enormous potential energy for the adult worker; checks on tissue waste; preventives of rheumatism and calculus, and tissue builders for the aged; and aids to digestion for all. We have also special foods for the diabetic, the constipated, the dyspeptic and the convalescent, some of which might appropriately be advertised as sure preventives of longevity.

These foods are all successful from a pecuniary standpoint, for the public not only likes to be fooled, but is en-

couraged in its folly by the unconscious connivance of the profession who should no more permit the use of secret foods than of secret medicines. And it is further encouraged in its folly by certificates and reports based on insufficient and unscientific data, signed by graduates in medicine who may or may not be creatures of the imagination, and worse than all, may take the foods by order of the medical adviser.

In the course of my work during the past fifteen years I have had occasion to analyze a very large number of these foods, and am prepared to assert that I have yet to find a patent food which is not either a quite unnecessary and comparatively expensive substitute for ordinary food, or capable of producing harm rather than good.

The food nostrums may be divided into classes, as follows:

Some are simple frauds, incapable of producing harm, and equally incapable of exercising any of their advertised curative influences, but containing a reasonable amount of nutriment. There are many of this class, and two examples will suffice. A more or less popular food for dyspeptics, guaranteed "to instantly relieve acid or sour stomach, abnormal hunger, and sinking all-gone feeling," "to prevent the injurious effects of ice water," and "to relieve any trouble arising from indigestion," proves to be a very innocent meal, costing about ten times as much as corn meal or graham flour, made from the refuse of a popcorn factory, and quite free from added substances which might neutralize acids in the stomach. Another of this class, which at present is being well advertised, is a form of bread which is supposedly endowed with the property of self-digestion; it is said to be made with the addition of malt extract before being put into the oven, a needless waste when one considers at what low temperature the ferment diastase is killed.

A second class includes such as are perfectly harmless and abundantly nutritious, but expensive and unnecessary, since the same dietetic results may be achieved quite as pleasantly and much more economically with the materials at hand in every kitchen.

In another group may be placed the infants' foods and substitutes for mother's milk. Most of the manufacturers of these preparations are willing to concede that Nature is a good guide to follow, and attempt to imitate her food; but they are not unanimous on this point, for there are those who, not satisfied with things as they have been created, have improved on Nature's methods and given us foods which they advertise as "superior to mother's milk." The infant foods may be divided into those made from cow's milk and those intended to be added to cow's milk, either to enrich it or to favorably affect its digestibility. Since it is impossible to reduce milk to a dry powder which, when treated with water, will again assume its original form, and since milk containing a normal amount of fat would tend, even if well concentrated, to quickly become rancid, and since another valuable constituent, the proteids, would become incurably altered in character in the process of drying, the manufacturers are driven to remove the (for their purposes) objectionable fat, and to add other substances foreign to milk, as cane sugar, malt sugar, dextrin and starch, so that a powder may be obtained, and then they impudently claim that their finished product, by virtue of this treatment, is either made to closely resemble human milk or to surpass it in nutritive value.

The other infant foods intended as additions to cow's milk are made from cereals which should have no place in the food of young infants whose digestive organs are not yet ready for substances foreign to milk. When all that is needed to imitate natural food for infants is milk sugar, and water, and milk, which can be separated into cream

and skimmed milk; and when with these four simple substances one needs only to know how much of each is required for the mixture; how can we justify the use of the expensive substitutes which introduce foreign substances, starch, dextrin, malt sugar and cane sugar, into young stomachs which are doing well enough if they can digest what Nature intended they should? And not only do they introduce foreign matter, but unless they are fortified by milk or cream they furnish a very insufficient proportion of fat.

A fourth group may include those foods which are harmful to the particular class to whom their use is commended. Here we may place all the diabetic flours and biscuits and breads. What would be thought of a physician who should order for his diabetic patients unlimited sugar candy, dry crackers and white bread? No answer is necessary, but such a course would be not much if any worse than permitting them to use the commercial diabetic foods. Some years ago I exposed to the profession the character of all the diabetic foods in the market. Since that time I have examined such new flours as have appeared, but I have yet to meet one made from cereals which does not contain a liberal supply of starch, and most of them are as rich in it as whole flour.

The fifth and last group includes those which may act unpleasantly, injuriously or even dangerously to sick and well alike. Who would direct that a patient suffering from weak digestion and irritable stomach should be given a nauseous mixture of beef blood, sheep's blood and glycerin? Would a knowledge of the character of the ingredients tend to assist the patient in retaining and digesting it? Add now to the mixture some fruit juices or syrup. Is it thereby improved, or made more nauseous and repulsive? But this is not enough; in order that this food may be preserved indefinitely without the body, let us now add a substance which will also retard its digestion within the body

and at the same time irritate the stomach, the kidneys and the bladder, namely a liberal dose of salicylic acid. With this addition the mixture now resembles the animal arcana so much in demand for making blood in anæmic persons, building up convalescents, furnishing strength to the weak and strong alike, and rescuing from the hand of death the sufferer from wasting disease. To this class belong also the canned and bottled clam broths, that waste product so poor in nutriment and so rich in chemical preservative. Such also many of the horde of alcoholic beverages masquerading under the magic name of Malt, with their freedom from diastase and richness in salicylic acid.

Such, then, are the patent foods so widely advertised in print and by the gratuitous distribution of sample packages —all unnecessary and expensive, some harmful as well.

We attempt to educate the people as to the desirability of purity in the common articles of food so that they may understand the dangers of adulteration, and then we leave them the helpless prey of the crafty medical food specialists. We ought rather to continue to teach them that it is to their physical and pecuniary advantage to avoid nostrums of all sorts, and that the proper feeding of children and the sick can be carried out more intelligently, more beneficially and more economically with the food materials in common use which need no fancy names and claim no medicinal virtues.

ARTICLE XXXVIII.

TREATMENT OF CONSTIPATION.

By FRANZ PFAFF, M.D.
OF BOSTON.

READ, BY INVITATION, JUNE 8, 1897.

TREATMENT OF CONSTIPATION.

THE best treatment in a given case of constipation will be the one by which the cause of the constipation can be removed. But the causes are very numerous. If a retroflexed uterus is properly replaced, an intestinal stricture dilated or operated on, anæmia cured or congestion of the lungs relieved, the accompanying constipation may be cured. Dozens and dozens of pathological conditions may cause constipation. It is not my intention to speak of all the different ways in which constipation has to be treated rationally according to its causation. I shall only deal with the treatment of cases which are generally classed under the head of simple atony of the intestines, and in which peristalsis is believed to be insufficient.

In the treatment of these cases of atony of the intestines, it may be necessary to employ all the therapeutic agents available. Hygienic, physico-chemical, dietetic and medicinal measures, even suggestion and hypnosis, either alone or combined, may prove beneficial if regularity and perseverence in the treatment are maintained. Regular habits, out-door exercise, gymnastics, hydrotherapy, massage or electricity may alone prove sufficient in many cases of constipation.

But there still remains a vast number of cases of constipation which do not yield to such measures and in which we must promote peristalsis by other means. This may

be done by diet or by medicinal agents. It is of these two factors I wish to speak very briefly. The dietetic treatment ought always be tried first, and if faithfully adhered to will often prove successful.

Of what should this dietetic treatment consist? The general rule is to increase in the daily meals vegetable matter, such as fresh green vegetables, fresh or dried fruits and the various grains. Further, to use the coarser breads, such as rye bread or graham bread, etc. The aim of this dietetic treatment is to introduce with the green vegetables and fresh fruits, more water into the system, and at the same time, what is more important, to increase peristalsis through the stimulation of the intestine by the undigestible substances found in greater amount in vegetable material than in meats or fats.

There is absolutely no doubt that a great many cases of constipation improve under the treatment just outlined, and many even recover. But, on the other hand, there still remain many which are not benefited, but are often even made worse.

In spite of frequent failures, the principle of the treatment is not wrong, but only the application of it in special cases. The fault lies in making the increase in coarse vegetable diet without discrimination. A strong, fat, constipated patient whose digestive powers are normal, may improve remarkably under such a diet, and his constipation be relieved for months and even cured. If, on the other hand, the same dietetic regime is prescribed in a case of chronic constipation, in a feeble patient with weak digestive powers, the result may be quite different. The constipation may become aggravated and the patient even lose strength and flesh. The reason for this is that the absorption of the real nutritive elements from our food stuffs is easier and more complete when they contain little undigestible matter than when they are loaded with such insoluble stuffs as cel-

lulose, of which coarse vegetable material contains so much. And it is just this cellulose which is believed to act as the main stimulus to peristalsis.

The dietetic treatment of constipation is a much more complex problem than is generally thought and believed.

Any one who has examined the dry fæces of cases of constipation microscopically and chemically will know how loaded they may be with vegetable waste products, and that the abundance rather than the lack of such undigestible matter should here be adduced as the cause of the constipation. The strength of the peristaltic movements are here entirely insufficient for expelling such an amount of waste products. If in such cases of constipation the quantity of undigestible matter of vegetable origin be reduced by the suitable choice of certain articles which have less cellulose, etc., but an equal amount of salts and carbo-hydrates, mucilage, pectins and other colloids soluble in water, the symptoms would very likely disappear, and the patient gain in weight. Recovery depends not only upon introducing vegetable matters into the intestine, but upon choosing such vegetables as are suitable to special cases.

Several different factors contribute to the good influence which the vegetable substances have on constipation. Of these the following are the more important:

1. The transformation of carbo-hydrates into CO_2 and fatty acids such as acetic, butyric, etc. These fatty acids, it is true, are nearly entirely lost for nutritive purposes, but they stimulate peristalsis of the small intestine and so hurry the contents through more quickly, thus causing them to reach the large intestine in a more liquid form.

2. Further, the presence of the different neutral salts and gums, mucilages, pectins and other colloids contained in vegetable material are most curative in an increased vegetable diet. The sugars are entirely absorbed in their passage through the intestine, but they are not so very easily ab-

sorbable from their watery solutions, and therefore keep the contents of the small intestines longer in their liquid form. The colloids, soluble in water, act in much the same way. The different neutral salts act in two ways. They also keep the intestinal contents in a more liquid form and act directly as stimulants to peristalsis.

Of the action of salts I shall speak more in detail when treating of medicinal agents.

The good influence attributed to the presence of water and undigestible material present in vegetable matter is of less importance. An excess of undigestible matter may even be hurtful.

Vegetable material containing a large percentage of tannic acid, such as blueberries, cocoa, chocolate, tea, have also to be avoided on account of the constipating action of this acid. The formation in the small intestines of fatty acids which act normally as stimulants to the peristalsis of the small intestines may of course be increased by adding fats to the diet. If the diet list is made up according to the principles just laid down, even a feeble constipated patient with weak digestive powers will be benefited, as he will have all the benefits of the vegetable diet without the unnecessary extra work of getting rid of too much undigestible material.

However, there still remain patients in whom, in spite of attention to general hygiene and diet, medicinal agents must be given to facilitate or promote peristalsis. These agents may be properly divided into two groups, the inorganic salts and the different organic compounds. The inorganic salts are subdivided, according to their action, into two classes, the chloride of sodium group and the sulphate of sodium group. To the chloride of sodium group belong all neutral salts, which are easily absorbed in the small intestine from their watery solutions. The beneficial effect which chloride of sodium and its allies have on constipation, is in promoting absorption of food stuffs and peristalsis of

the small intestine. These salt solutions are entirely absorbed in the small intestine and excreted with the urine. But during the passage through the small intestines, these salt solutions stimulate absorption and peristalsis, and hurry along the contents, so that they reach the large intestines in a more liquid form.

Here then, the inspissation of the remnants will not be so complete as to hinder their expulsion.

To the sulphate of sodium group, on the other hand, belong all the salts difficult of absorption, such as sulphate of sodium, sulphate of magnesium and other magnesium salts, the phosphates and tartrates. All these salts are absorbed with difficulty in the intestinal tract, and are expelled for the most part with the fæces, and not with the urine. In their passage through the intestinal tract, they prevent the absorption of water, and thus keep the intestinal contents, even in the large intestines, in a more liquid form, thus facilitating their expulsion.

The large group of organic compounds used in the treatment of constipation act, so far as we know, mainly by producing peristalsis of the large intestines. I will only mention rhubarb, senna, cascara sagrada, aloes, gutti, elaterium, colocynth, jalap and croton oil. It would take too long to describe the special merits of each of these; suffice it to say that some are powerful irritants, and have, therefore, to be used very cautiously; while others, like senna, cascara sagrada, have less irritant properties and may be given with impunity for long periods.

From this very short description of the main characteristics of different medicinal agents, their indications for use may, nevertheless, be deduced. But before doing this, I may be permitted to draw your attention to another medicinal agent, which in helping normal absorption in the small intestines and promoting intestinal peristalsis, may be used with success in the treatment of some cases. If dried

ox bile be given in suitable form and in sufficient quantity, constipation may be relieved even in very obstinate cases. When given in salol-coated pills to prevent absorption from the stomach and in large quantities, fifteen to thirty grains three times a day, before meals, the evacuation of the bowels may become entirely normal. Bile acts mainly on the contents of the small intestines, and the indications for its use are, therefore, limited. But we have seen that not enough stress has been given to the conditions of the contents of the small intestines in the treatment of constipation. In many cases, the accumulation of fæcal matter in the large intestines is thought to be entirely due to the imperfect peristalsis of this organ, and the treatment is directed to it, often with varying results, whereas a modification of the contents of the small intestine would prove curative. In concluding the short list of medicinal agents employed in the treatment of constipation, we must not omit atropine and physostigmine. The latter acts in stimulating the unstriped muscles of the intestine, and may, therefore, prove beneficial when these have to be strengthened. Atropine acts in the opposite way. It paralyzes undue contraction of the muscles of the intestine. If constipation be due to spasmodic contraction of the intestine, it may overcome this spasmodic contraction and allow the evacuation of fæces, which could not be accomplished otherwise by the strongest aperient.

Morphia, which in general favors constipation, may also relieve spasmodic contraction. In speaking of spasmodic contraction of the intestines as a cause of constipation, especially in nervous persons, I will only add that Kussmaul and Fleiner, in 1893, described this form more in detail, and recommended large oil enemas as the best means of overcoming the spasmodic contraction and helping evacuation of the retained hard fæces. These large oil enemas may also be used with great advantages in cases of simple atony,

where retention of fæcal matter is present in the large intestine.

Now to the indications for medicinal agents!

If we intend to promote absorption of food stuffs and peristalsis of the small intestine, we ought to use the substances belonging to the group of common salt. Mineral waters containing mainly this substance are Wiesbaden and Kissingen. To this group may be added bile. If we intend to promote peristalsis of the large intestine, the different organic aperients or laxatives have to be used. In case our intention is to keep the contents of the large intestine less solid, salts like sodium and magnesium sulphate and other salts difficult of absorption have to be employed. Very often it is best to give a combined medicinal treatment, that is to say, one which keeps the contents less solid and helps peristalsis along at the same time. In such a way we shall need to use less quantities of drugs to obtain the desired effect, than if we used a medicine acting in only one direction.

But even in cases where we have to use medicine, the attention to diet must be paramount, and if carried out with perseverence will often permit of dropping medicinal treatment entirely, which must be the desideratum in the treatment of constipation.

ARTICLE XXXIX.

ENTEROPTOSIS.

By MARY P. DOLE, M.D.
OF GREENFIELD.

READ JUNE 8, 1897.

ENTEROPTOSIS.

Mrs. A.—Was first seen in July, 1893. Was confined one year previous,—labor difficult,—forceps delivery. Has not been well since. Feels tired. Pain in iliac regions and in soles of feet. Backache. Appetite good, sleeps well, bowels fairly regular.

The cervix and perineum were found badly lacerated, and an operation for their repair was advised, with the expectation that the patient would be wholly relieved.

She was next seen two years later. The lacerations had been repaired, but the patient had gradually grown worse. Has much pain in right lumbar region, especially after standing or walking,—the pain extends down the leg and up into shoulder. The backache has increased. Has lost some in weight. Gets tired easily. Is constipated and very nervous. Examination of the abdomen showed: epigastric region depressed, slight distension below umbilicus,—stomach reaches one inch below umbilicus,—whole of right kidney and two thirds of left easily felt,—lower border of liver one finger's breadth below ribs.

Miss B.—First seen in 1892. Has always been delicate. Has much backache. Considerable flatulence and acidity of stomach; occasional nausea and vomiting, but vomits only small amount. Is inclined to be constipated. Menses regular, considerable dysmenorrhœa.

Pelvic examination:—Uterus retroposed. The displacement was corrected, but with no relief to the patient. The various digestive ferments, antiseptics and tonics, and, by the advice of a New York specialist, lavage of the stomach, were tried with equally bad results. The patient was seen again a year ago. Condition about the same.

Abdominal examination:—Epigastric region depressed, slight distension below umbilicus, whole of right kidney easily felt, lower border of liver one inch below ribs, stomach reaches a little below umbilicus.

I have given a brief outline of these cases, not because there is anything striking or unusual about them, but rather because they are every day cases with all of us, and also because they belong to a very large group of cases to which we formerly gave the names of dilated stomach, floating kidney, neurasthenia, chronic dyspepsia, nervous dyspepsia, or nervous something, but now are looking at them more and more as cases of enteroptosis.

The word enteroptosis, strictly speaking, means a falling of the intestine, but as used at present, it has a more general significance, being applied to a downward displacement of some or all of the abdominal organs. A displacement of portions of the intestine and of the other abdominal organs has long been recognized as an anatomical fact, but its importance as a pathological condition has only within the last ten or twelve years begun to be appreciated. It was in 1886, I think, that Glénard presented his paper on this subject before the Medical Society of Paris, and this marks the beginning of our present conception of this extremely common condition.

The organs most often affected are: first the right kidney, then the stomach, transverse colon, liver, left kidney and spleen. The displacement may be congenital or acquired.

The causes of the acquired form are: 1st, those which produce a relaxed condition of the abdominal walls; and 2d, those causing downward pressure on the abdomen. In the first group the most important are, child bearing, diseases producing much general debility, *e.g.* tuberculosis, typhoid fever, anæmia and neurasthenia, and mal-nutrition from insufficient or improper food.

In many cases of anæmia and neurasthenia, however, the enteroptosis is probably the cause rather than the effect.

In the second group are: lacing, letting the skirts drag down on the abdomen, overwork, lifting heavy weights, etc.

In considering cases of enteroptosis, we have to take into account the fact that nearly always there is associated with the displacement a myasthenic or atonic condition of the stomach and bowels, and often it is to this more than to the displacement that the subjective symptoms are due. It is also true that a considerable degree of enteroptosis may exist without producing any symptoms. Such cases, however, are exceptional.

In the diagnosis we have to consider the subjective symptoms, objective signs, and the course of the disease.

The most common symptoms are a feeling of fulness and pressure in the epigastrium, flatulence, cardialgia, variable appetite.

The stomach symptoms differ from those found in most other diseases of the stomach by being more irregular. They do not depend upon the kind of food taken nor upon the stage of digestion; *i.e.* they are just as apt to occur after taking liquid as after solid food, or when the stomach is empty as when full, and *vice versa*. An almost constant symptom is habitual constipation, in some cases alternating with diarrhœa. The constipation is due partly to the atony of the muscular coat of the intestine, and partly to the abnormal flexing or doubling up of the intestine by its prolapse, which interferes with the peristaltic motion.

In many cases the nervous symptoms are the most prominent. There is often headache; almost always more or less backache, frequently pain in the abdomen which wanders about from one place to another.

Patients with enteroptosis are, as a rule, thin, spare people, and, therefore, it is comparatively easy to make out the position of the different organs. The stomach is found

reaching to or below the umbilicus. The whole or part of one or both kidneys is to be felt. The transverse colon is descended; also in many cases the liver and sometimes the spleen.

Examination of the stomach contents shows that digestion in the stomach is normal, or perhaps retarded. In the morning the stomach is empty or contains simply a small quantity of gastric juice, with perhaps some bile, but no food.

The disease runs a chronic course, with many remissions and exacerbations. In the more marked cases nutrition is much interfered with. The patient loses in flesh and strength. Is easily fatigued. Of some diagnostic value is the favorable effect of physical and mental rest, and the opposite. The patient feels fairly well if she does but little.

The only disease which I shall consider in the differential diagnosis is dilatation of the stomach, or more correctly termed mechanical insufficiency. Until recently every stomach that reached to or below the umbilicus was considered dilated. Further careful study has proved that a great majority of these are simply descended, and that cases of mechanical insufficiency are comparatively rare.

A very characteristic symptom of mechanical insufciency is the vomiting at intervals of large quantities of food and liquid, which, on standing, separates into three layers. The lowest consists of food, the middle of a grayish, turbid fluid, the upper of a brownish froth. The vomited material may contain food that was eaten two or three days before.

In enteroptosis the amount vomited is small and does not contain food eaten the previous day.

In mechanical insufficiency thirst is much increased, the amount of urine passed in twenty-four hours is lessened and the skin becomes dry,—symptoms which are not usually present in enteroptosis. In mechanical in-

sufficiency the emaciation is more marked, the stomach symptoms are more regular and their intensity is more dependent upon the kind of food taken.

In cases of doubt, very conclusive evidence can be gained by giving the patient a test supper, consisting of cold meat, bread and tea, and then the next morning examine the stomach contents.

If there is mechanical insufficiency a considerable quantity of food and liquid will be present, having a characteristic sour odor, and, on standing, separating into three layers. Under the microscope one finds yeast fungi and sarcinæ, whereas if it is a case of gastroptosis the stomach is either empty or contains only a small amount of gastric juice. No food is present, and the yeast fungi and sarcinæ are wanting.

Prognosis:—The disease carries with it no serious danger to life, but, in most cases, it does reduce one's power to do either physical or mental work, and often the patient is more or less of an invalid all her life.

Treatment:—Remove as much pressure and weight from the abdomen as possible. Corsets should not be worn. The patient should wear few skirts and light ones, and these should be supported from the shoulders. Give a very nourishing diet,—one rich in carbo-hydrates and fats, plenty of good milk, cream and butter.

Tone up the muscles of the abdominal wall, stomach and bowels, by cold bathing and rubbing, and, best of all, by abdominal massage and the Faradic current. In some cases an elastic abdominal binder gives much relief to the patient.

The medicinal part of the treatment is very secondary. Strychnia probably does good, and, where there is much flatulence, resorcin or beta-naphthol may be of service.

In regard to the displaced kidneys, the question of nephrorrhaphy will often come up. In many, probably in

most of the cases, the symptoms are due more to the displacement of the other organs, so that until a way is found of stitching up all the abdominal organs, the patient cannot be wholly relieved by surgical treatment. However, there are cases in which the chief suffering is due to the nephroptosis, and in these cases nephrorrhaphy is of benefit to the patient.

I wish to acknowledge my indebtness to Prof. Litten and Dr. Boas of Berlin, in whose clinics it was my privilege to study for a time, and to whom I owe the few thoughts which may be of interest in this paper.

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ARTICLE XL.

THE ANNUAL DISCOURSE.

THE RELATION OF PATHOLOGY TO MEDICINE.

By WILLIAM T. COUNCILMAN, M.D.
OF BOSTON.

DELIVERED JUNE 8, 1898.

NOTE.—At an Adjourned Meeting of the Massachusetts Medical Society, held Oct. 3, 1860, it was

Resolved, "That the Massachusetts Medical Society hereby declares that it does not consider itself as having endorsed or censured the opinions in former published Annual Discourses, nor will it hold itself responsible for any opinions or sentiments advanced in any future similar discourses."

Resolved, "That the Committee on Publications be directed to print a statement to that effect at the commencement of each Annual Discourse which may hereafter be published."

THE RELATION OF PATHOLOGY TO MEDICINE.

Mr. President and Fellows
of the Massachusetts Medical Society:

We may safely say that in the past fifty years there has been a greater advance in our knowledge of disease and in our methods of treating it than in any other similar period of the world's history. Not only has our knowledge of disease increased, but with it has come from all sides a larger appreciation of the importance of definite knowledge in the practice of the medical art, and the facilities for the study and investigation of disease are constantly increasing. With the increase of knowledge it has been possible to apply more fully scientific methods of investigation and reasoning to medicine. It is becoming more and more a science and daily removed farther from the field of speculative philosophy. Close observation, hypothesis, and the test of the hypothesis by further observation, comparison and experiment, have taken the place of speculation. The advance has not been pre-eminent in any one department of medicine but along the whole line. Every advance in the knowledge of disease has been followed by a practical application of the knowledge resulting in

better methods of treatment. Often those very facts which were seemingly of least practical importance have yielded the greatest practical results. Certainly no one could have foreseen that the discovery by a French chemist that carbolic acid would arrest the progress of fermentation and destroy the lower forms of life, would be followed by Lister's method of wound treatment.

Medicine has a greater interest for the layman as well as the physician and inspires in him a greater respect and confidence. Almost a new field has been opened to the humanitarian instincts of the people. Hospitals have been erected everywhere; and in their construction and maintenance nothing has been spared which could add to the comfort and conduce to the better treatment of the sick within them. Laboratories have been erected in connection with the hospitals, in which the investigation of disease could be more efficiently carried out. In the hospitals, in addition to the physicians and surgeons who are actively engaged in the treatment of the sick, there are men whose work is only in the laboratory and who do not come at all, or only rarely, in connection with the sick. The work of these men lies in two directions. In the first place by means of the study of tissues or fluids from individual cases, they assist in the diagnosis and thereby in the treatment of the sick. In addition to this their work consists in the study of questions concerning disease, which study is facilitated by the opportunities which the hospital gives.

A broader conception of the work of the hospital has arisen. It is now generally held that in addition to the treatment of the sick within its walls, the hospital has other duties. It is in hospitals that the study of disease can be most efficiently carried out. Large numbers of sick, with different forms of disease and with different stages of the same disease, are grouped together; and the opportunities for observation and investigation are much better than can be afforded by the sick in private practice. Both the medical profession and the public demand that, in exchange for the opportunities which the hospital gives for the education and development of the practitioners, those holding positions in it shall by their work contribute to our knowledge of disease.

In the first volume of his *Archives*, published in 1847, in the famous article in which he laid down the lines along which medicine was to advance and along which it has advanced, Virchow says, "the filling of the clinical positions in a hospital has now become a matter of supreme importance because the clinician must not only be a scientific practitioner, but also an observer and investigator." The importance of this view of the hospital has been borne out in the histories of all the great hospitals. The work which such hospitals as Guy's, or the Charité Hospital in Berlin, has done in the actual relief of suffering is as nothing compared with the benefits which the hospital has rendered mankind in the increase of knowledge which has come from the study of disease within its walls. It is only

by means of their connection with great hospitals that the work of such men as Bright, Traube, Frerichs and others has been rendered possible.

Our conception of medical education has also changed. It is considered no longer sufficient that the student should be told things. The laboratory and the hospital ward have become more important factors in medical education than the lecture-room. We are becoming more convinced that the student must be taught not only the art but the principles on which the art is founded. He can obtain his knowledge in great part by personal observations and experiment, for in this way only can knowledge come. It is of more importance that the powers of observation and the faculty of scientific reasoning should be cultivated in the student than that he should memorize supposed facts.

That branch of medicine which we term pathology has possibly felt the quickening influence of science more than any other. New fields have been opened to it. It has come in closer connection with biology on the one hand and with the practice of medicine on the other. As comparative pathology it has become an important element in the economy of the country. New methods of investigation in anatomy and physiology have been quickly applied to the study of problems in pathology. The close association and the mutual interdependence of pathology and clinical medicine cannot be questioned. This is so fully recognized that the trustees of hospitals are willing to erect

and maintain, at a considerable expense, buildings in which it shall be studied.

I have thought that it might not be without interest to you to learn from a pathologist something of pathology, its position in the natural sciences, its relation to clinical medicine, its problems and its relation to the medical student.

Pathology may be defined in a broad sense, as that branch of biology which has to do with the study of life under abnormal conditions. It is impossible to define life. When matter has certain attributes, when it reacts in certain ways to external influences acting upon it, it is called living matter; and these attributes and reactions common to it in all forms are sufficient to distinguish living matter from all other forms of matter.

The phenomena which living matter exhibits, whether it be in the form of a simple unicellular organism or in the complex form of a mammal, under the influence of external conditions, constitute the phenomena of life.

When we study simple unicellular organisms under the microscope, we can in various ways change the conditions which surround them and observe the phenomena which they exhibit under these varying conditions. We find certain conditions which are favorable for them. Under these they absorb food to supply the material which is lost in the production of force; the protoplasm increases in amount, new individuals are produced by the division of the cell, and the species preserved. We can subject them to a greater or less degree

of temperature, or expose them to the action of chemical substances, observing them all the while. Under such influences we find that the phenomena which they exhibit change their character. By gradually increasing the temperature, the movements of an ameba at first become more rapid, then slower, and finally cease. We can also influence in some degree the amount and character of the substances which certain unicellular organisms produce. Or again, we can so alter the external conditions that the simpler phenomena of life, as shown by alimentation, can be carried on; but there may not be sufficient force conveyed to the organism to enable it to perform the more complex phenomena involved in reproduction.

Slight variations in the external conditions have no effect on the phenomena which living beings exhibit. The movements of an ameba or the movement of the cilia in a paramesium or a bacterium will continue in the ordinary manner if the temperature be raised or lowered only a few degrees above or below that in which they ordinarily live. The external conditions to which living beings are subjected are constantly varying; not only does the temperature vary but the quality and amount of substance serving for food are constantly changing. This capacity of living under such varying external conditions is spoken of as physiological adaptability or resistance. It is only necessary to think of the conditions under which man lives to see how great is this physiological adaptability of the organism. This is only possi-

ble by means of the mutual interdependence of the organs. Under certain conditions more work will be thrown on one organ of the body than on another, or the function of one organ may be so modified that it will act in such a way as to be of advantage to the others. One of the best examples of this interdependence of organs is seen in the action of the skin and kidneys. Physiology teaches us every day more and more of the marvellous ways by which the circulation adapts itself to meet different conditions.

A certain degree of variability in the phenomena is perfectly consistent with a state of well-being of the organism. We call the state produced in living beings by unfavorable external conditions which pass beyond the adaptability of the organism, disease; and the phenomena exhibited under these conditions, symptoms or signs of disease. The phenomena produced in disease are due to alterations of structure. Unfavorable external conditions produce an alteration in the structure of the living material in consequence of which it exhibits different phenomena. These alterations in structure which result from unfavorable influences and to which the phenomena of disease are due, are called lesions. In most cases these lesions are sufficiently obvious. They may be present in a single organ or may be widespread. In rare cases we are unable to recognize them with the means at our command, although we must assume them to exist. With the increase of our technical method of study, we daily become better able

to ascertain the character of these structural alterations, but even now it is only the more obvious alterations which are accessible to our study. It is perfectly conceivable that there may be alterations in chemical composition which we may not be able to recognize and which may exercise an important influence on function.

When a number of living beings are subjected to unfavorable conditions, all being equally exposed, they will not be equally affected. If the conditions are sufficiently unfavorable, the majority may be destroyed and only certain individuals survive. The same thing is seen in every tale of shipwreck and privation; certain individuals remain alive while others perish. Although for every species of living beings we can determine in a general way the limits of the unfavorable conditions under which life is possible for the vast majority, certain ones will always be found which will not come up to or will pass beyond the standard. Even in the observation of amebæ it is seen that not all will cease their movements at the same time when subjected to the same degree of heat. Some will cease to move before the majority are affected, others long after.

In dealing with living matter we are not dealing with chemical substances of known character in which the same effect is produced by a given cause, but with highly complex substances. Not only does every species, as species, have a law of its own, but even every individual of a species has a definite individuality, and may show in va-

rious degrees differences in power of resistance, and in other ways depart from the standard. The variation in physiological resistance may not show itself by any difference which can be demonstrated. It is not possible from the most minute examination of a number of amebæ of the same species to designate in advance those which will prove to be more resistant to heat or chemical substances. The greater resistance may depend upon certain substances which are present in larger quantities in some individuals, or upon a greater firmness or regularity in the chemical molecules. This variation in physiological resistance becomes more complex in the higher animals, which are not composed of single units capable of independent life, but of aggregations of units arranged in organs and all interdependent.

Pathology being the study of disease, all that belongs to disease comes within its province. It has to do with the unfavorable external conditions, the causes of disease in their action on the living body. Here it has a close relation with hygiene, which is the general study of the causes of disease in relation with other external agencies and the means for preventing their action. It has to investigate those conditions underlying disease in consequence of which the physiological resistance of the organism to external conditions may be lowered. It must embrace the study of the lesions produced by these varying causes and the manner of their production. These lesions may be produced in the embryo and in various ways influence

its development. In the study of the lesions there is a close union with anatomy and embryology. The anatomical lesions produced by disease affect in various ways the functions of the different organs, and the disordered functions and the general phenomena of life of the diseased individual must be studied. In this pathology is closely related to physiology, or the study of the phenomena of life in normal individuals.

Pathology must be more than a descriptive science. It must be explanatory. The most exact description of a pathological lesion can give little information of the manner in which the lesion is produced, and still less of the effect which the lesion will have on function. The study of the lesion in itself, although the tissue change may be interesting, is as void of wide interest as the study of human anatomy separated from comparative anatomy and embryology. Pathology must explain the lesion; and this involves the study of the cause, the manner in which this cause acts on the tissue, how it reaches it from the outside, the gradual changes which the tissue undergoes in the production of the lesion, the effect of the lesion on the function of the tissue in which it is situated, the influence of the disordered function on the general organism, and the means by which the diseased tissue is repaired or regenerated. The methods used in the study are the same as in any other science, observation and experiment. Experiment is as indispensable in pathology as in any other branch of science.

Such being in brief a general view of pathology, let us consider a little more closely the subjects for investigation. Teratology, embracing the cause, the modes of formation and the influence exerted on the entire organism by malformations, may properly be considered a branch of pathology. As such it is closely linked to embryology, and its problems must be attacked from the embryological point of view. The explanation of the mode of development of the malformations can only be fully appreciated by those who have made embryology their chief study. The malformations, constituting as many of them do such obvious departures from the normal type of the individual, have been from the beginning of the study of pathology objects of description. No attempt was made to classify them, or to ascertain their cause. Then came the period in which the malformations were grouped together, classified and arranged in the order of those affecting the entire individual, and those affecting certain organs. A still further mode of classification involves some conception of their manner of production. It was seen that some of them were due to a separation of parts. Many of them were seen to represent the persistence of a condition found only in the embryo. In the first attempt to ascertain their etiology they were considered, as were diseases at that period, to be manifestations of the wrath of God. Their study advanced from the age of superstition to that of speculation. In the speculative age they were attributed to the intercourse of human be-

ings with animals and to the influence of mental states of the mother on the fetus *in utero*. The first great advance which was made in their study was when it was ascertained that under the influence of unfavorable external conditions malformations could be produced in the eggs of chickens and fishes. With these observations began the study of the experimental production of malformations to which Dareste in France has made the most important contributions. He showed that it was possible to produce certain of the more common malformations in chickens by subjecting eggs to various abnormal conditions, such as shaking them, standing them on end, subjecting them to variations in temperature, etc. All of these external conditions exert an influence on development. With few exceptions, however, it has not been possible to produce at will any given malformation.

The results of this study, together with observations on abortive human embryos, have shown that most malformations take place at a very early period of embryonic life. The observations of Dareste have been carried still farther, and the study of malformations from the experimental point of view has become the main work of certain embryologists in Germany and in Italy. Even in this field, which at first sight would seem farthest removed from experimental inquiry, the experimental method has given the only results of importance. Experimental teratology has now investigators in this special field, laboratories de-

voted to it and an important periodical literature. There is little doubt that certain problems in normal development may be elucidated by the study of the abnormal, in the same way that our knowledge of normal structures and function has been increased by the study of disease.

Teratology has a further important connection with pathology, in that malformations constitute a part of the underlying causes of disease, those conditions of the organism which render it more susceptible to the action of unfavorable conditions. Many of the questions relating to immunity and to inheritance may also be considered under it. In all of these questions there remain problems enough for investigation.

The study of pathological anatomy may be said to have passed through a period very similar to that of teratology. In the beginning pathology was only concerned with the curious. In the first books on the subject we only find descriptions of very obvious departures from the normal type, together with an imperfect account of the symptoms of the individuals, a collection of curious and often interesting facts without attempt to harmonize them or to explain them. Then came the period of better observation of the lesions and their classification; and this reached its acme under Rokitansky, who may be said to have occupied the same position in pathology that Linneus did in botany. Even to-day nothing can equal the accuracy of Rokitansky's observations. There are few things which he did not see. When some

lesion or combination of lesions seems entirely new, it is often only necessary to go back to the work of Rokitansky to find that he has observed and accurately described it. Rokitansky made pathology or pathological anatomy a descriptive science. In his attempt to *explain* the pathological alterations he so faithfully described, he had recourse to speculation, elaborated his theory of crasis, and by his force of presentation succeeded in having it generally adopted. According to this, all pathological conditions were due to a certain state of the system known as the crasis. In all pathological new formations a mother fluid was produced, which was termed the blastema; and under the influence of a particular crasis, in the one case, carcinoma, in another case, pus, or in another case, tubercle, could be formed from the blastema.

This school of pathology reached its full development under Rokitansky, and was a legitimate outgrowth of the speculative philosophy of Germany. Systems of philosophy developed in medicine as they had developed in other branches of learning, and from the beginning of this century up to the time of Virchow German medicine was largely founded on metaphysics. The case was different in England. Here medicine had felt the magic influence of John Hunter. He discarded speculation entirely and went back to observation; and it was due to his influence that English medicine advanced. In John Hunter were combined wonderful powers of observation and skill

in experimentation. In Rokitansky were combined powers of observation which have scarcely been equalled and powers of speculation almost as marked.

The successor of John Hunter was Virchow, and his work is the foundation-stone on which German medicine has been erected. Virchow may be said to have given us our present conception of pathology. He taught us that our study must embrace, not only the lesion as an anatomical condition, but its causes, its mode of formation and its influence on function. Before Virchow, Morgagni had taught us that disease was to be referred to the organs of the body. Bichat went much farther by referring it, not to the organs, but to the tissues composing the organs. Virchow went still farther in studying the changes in the cells, and gave us the cellular pathology. It was his great service to have fully appreciated the importance of the work of Schwann and his successors, and to have carried the principles of the cell theory into pathology. He was the first to recognize that pathology was the study of life under abnormal conditions, and that all we could gain from the study of physiology and embryology had a direct bearing on pathology. More than all, he taught us that the same methods of research which were used in the other natural sciences were to be applied to medicine.

There is probably little more to be done in the way of description of gross pathological lesions. There is much to be done in the study of the finer

cellular changes of organs, their causes and mode of production. Many of these changes have only recently, owing to improvements in optical instruments and in methods of investigation, been apparent to us. We are learning to investigate more closely, and that our investigations must have a wider scope. We recognize that lesions which are of great importance are not evident on examination with the naked eye; further, that we must often seek in slight lesions produced in one organ the causes of extensive lesions in another. In certain diseases, as in typhoid fever, the effect of the disease is seen in the production of cellular changes in all the cells of a similar character in the body. Local and general immunity are connected with changes in cells. It is no longer sufficient to investigate single organs in studying the effect of a cause of disease, but all the organs must be investigated. The pathologist is as much interested in cells as the histologist and embryologist, and all methods which facilitate their study in these branches find a quick application in pathology.

A new interest has been given to pathology, and new fields have been opened to it, by the discovery of the connection between lower forms of life and changes in tissue. The study of bacteria in their relation to disease must form an integral part of pathology. We have been able by the study of bacteria in connection with lesions to appreciate many important primary lesions which had previously escaped our attention.

More than this, we have been able to extend the field of observation by experiment. In the study of the pathological changes in man we are more or less dependent on chance for our material. The lesions we are investigating may be so advanced when obtained from the autopsy, that it is impossible to study their mode of formation. We are enabled by the inoculation of animals to obtain a lesion at any stage desirable for our study. Our knowledge of the histogenesis of the tubercle and of different forms of inflammation would have been impossible without such experimental methods. By inoculating animals of different species or animals of different ages, or varying the amount and virulence of the organism inoculated, we are able to produce experimentally, and to refer to definite causes, those variations of lesions of the same character which were formerly inexplicable. We have been able to recognize that certain lesions are due to the direct action of the organisms on the tissues, and that others are caused by soluble chemical substances, either produced by the bacteria themselves or by the tissues under their influence. There is unquestionably much work to be done in the study of bacteria, in their connection with botany and with hygiene. The study of their species,—their morphology, their products, their variations, the part they play in nature, and their general relations to disease,—does not come under the pathologist. The study of bacteria in their definite relation to pathological anatomical lesions is a part of pathology.

Under general pathology come the questions concerning those alterations of function which are the result of anatomical changes. General pathology has also been called pathological physiology, and bears much the same relation to pathological anatomy as does the study of normal function, physiology, to anatomy. The attempt has been made in the Austrian Universities to divide pathology into the two departments of general pathology and pathological anatomy, with separate laboratories and teachers for each. This was probably the result of the narrow conception of pathology by Rokitansky and the Vienna School. It was felt that something must be added to the narrow descriptive science of Rokitansky, and, instead of forcing a proper conception of the scope of the science, they made the mistake of dividing it. General pathology has also been considered as experimental pathology in contra-distinction to pathological anatomy, as though the experiment did not form one of the bases of pathological anatomy if we consider this more than a descriptive science. Considered in this sense, general pathology is the connecting link between pathological anatomy and the clinic, and its problems can be approached from either side. The pathological anatomist who pays no attention to general pathology loses the power of thoroughly understanding the character of disease. He could be compared to the clinician who would be contented with the observation of the symptoms of a disease. A pathology which does not come in contact with

pathological anatomy on the one hand, or with the clinic on the other, cannot progress, because it does not become acquainted with the character of the problems which disease presents. We owe many of the most important advances which have been made in pathology to those who have entered into it from a clinical point of view. The work of John Hunter in pathology is the most distinguished example of this connection between pathology and clinical medicine. It is seen also in the long list of distinguished English physicians—as Bright, Bennet, Addison, Gulliver, Williams and Fagge—who followed Hunter. The work of these men is important, not only in the actual contributions to our knowledge of disease which they made, but by following scientific methods they kept English medicine in the first half of the century free from the speculative philosophy of Germany. There can also be little doubt that the combined study of clinical symptoms with pathological anatomy makes the clinician broader and stronger. It is difficult to find a great clinician, either in medicine or surgery, who has not made important contributions to pathology. We have only to point to English medicine in the first half of this century and to German medicine in the last half, to see the truth of such a statement. It is especially here that the experimental method produces the best results. The pathological anatomist must resort to experiment to ascertain the effect of a certain lesion or function. The clinician can in many cases understand only by vary-

ing the conditions of an experiment in what way a lesion acts in producing symptoms. The experimental method as applied to the elucidation of symptoms has yielded fully as important results to the clinician as to the pathologist.

In a consideration of the means for the study of pathology the laboratory comes first. The laboratory is designed to give better opportunities for those who work in the subject. The methods used in pathological investigation are so numerous, so complicated and often so expensive, the apparatus used often requires so much space, that it is rarely possible for a private individual to provide himself with such facilities. The pathological laboratory is a recent creation and with the increase of opportunity which it afforded the advance of the science went hand in hand. When Virchow returned to Berlin, his departure having been occasioned in 1848 by an excess of political activity which the authorities regarded as pernicious, he made one of the conditions for his return, the creation of a pathological laboratory in connection with the Charité hospital. This example was followed all over Germany, and now no university and hospital is without its pathological institute.

In the United States there are numerous pathological laboratories, both in connection with teaching institutions and with hospitals. There has even been in this country the example of a pathological laboratory without any connection with either a medical school or a hospital, in which pathology was studied as a branch of university

work in biology, and as such, made important contributions to the subject. It is most interesting to compare the progress of medicine in England and Germany during this century. The conditions have been exactly reversed in the two halves of the century. The great advance which Germany has made in the latter half may fairly be attributed to the influence of the laboratories, the work of which in England was restricted both by the lack of means and by pernicious and meddlesome legislation.

The pathological laboratory should be considered from three points of view; but the different views obtained so merge into one another, and the different subjects are so interdependent that they form but special features of a single landscape. The three points are: *first*, its connection with a hospital in assisting in diagonsis and directly furthering medical art; *secondly*, a place in which all the opportunities for research shall be afforded; and, *thirdly*, a place for teaching. It is equally possible to view the hospital from such points of view, as a place for the best treatment of the sick, as a place for medical research and a place for teaching; and the excellence of development in any one of these aspects furthers the others. The best hospital and the best laboratory will be one in which all three sides are developed to the fullest extent.

First, In its connection with the hospital as a place where methods of diagonsis can be carried to a fuller extent than in the hospital. There has

been to a certain extent some attempt in hospitals to separate this part of the work which so closely appertains to the clinic, from the other work of the pathological laboratory, and to call the place where it is carried out, the clinical laboratory. No good can come from such a separation, no more than has come from the separation of general pathology and pathological anatomy. It is of the utmost importance that the worker in one department should come in contact with those who are studying in others. That the man who has come from the clinic, examined the urine of a man who has certain symptoms and found albumin and certain morphological products, should exchange ideas with a man who is studying the pathological changes in such kidneys. Each obtains a more comprehensive view of the disease. The presence of tubercle bacilli in sputum should call up not only the clinical picture which would be presented, but the condition of the lungs. It is possible that in certain points a greater advance might be made by such separation, but the broader point of view is lost. In the pathological laboratory should be contained every means which will facilitate such purely clinical investigations. They should in great part be carried out by the young men in the hospitals who themselves come in contact with the sick. Their work should be supervised by a man who is specially skilled in such methods of investigation and who can correct or assist them. Every day sees a greater advance in these clinical pathological investigations, and methods of exam-

ination become more complicated. Such investigations are of as much importance for the surgeon as for the physician. In the case of a tumor it is often of the utmost importance to know its exact character before operating. This knowledge will often determine the character and the extent of the operation. Nearly every disease, either medical or surgical, is more or less open to investigation by objective methods. An individual appears in the clinic with an inflamed throat, and we no longer surmise as to whether it may be a case of diphtheria without membrane formation or a membranous inflammation without diphtheria, but a culture is sent to the laboratory and the diagnosis is made on exact knowledge. It would take too much time to multiply examples. Experiments must often be performed in connection with such works. We are often only able to direct the presence of certain organisms by inoculating animals.

Next in the relation of the laboratory to the hospital comes the post-mortem examination. To make a post-mortem examination in a proper manner demands much more now than formerly. Bacteriological cultures must be made of every organ to determine not only the presence of organisms which may have been causes of disease, but the extension of the organism in the body. There may be primary infection and secondary infection depending upon this. The organisms found may be of great virulence or attenuation, which can only be told by inoculation. There must be a thorough investigation of all the organs; the char-

acter of the lesions, their cause, and the effect of lesion in one organ, in determining lesions in another, must all be borne in mind. Thorough microscopic examination must be made of all the organs, for some of the most important lesions of disease can only be determined by microscopic examination. We do not know any disease; exactly the same conditions are not found in any two individuals dying of the same disease. We should regard a disease as an experiment, and the conditions of the experiment are more varied than we could possibly make them. The post-mortem investigations should be made with a knowledge of the symptoms and all that can be learned from the clinical course of the disease, and especially by the objective methods of clinical investigation. Many conditions in the pathology of the circulation may become clear to us when objective methods of measuring blood pressure shall come into use. The work of the pathologist and the clinician should go hand in hand. The pathologist has a certain advantage in that the cause, histogenesis and relations between the lesions are for him a legitimate subject for investigation. The clinician cannot dispense with the pathological anatomical investigation unless he content himself with the bare diagnosis. The clinician should not think of the pathologist as a more or less useful individual who can sometimes give him information, nor should the pathologist regard the clinician as the blind instrument who under Providence furnishes him with material for

investigation. All the work of the laboratory should be carefully recorded and the records made easily accessible. In such a way the work of each individual may be utilized even when he works no more.

I trust I have shown how much the second part of the laboratory work, that of research, is dependent upon the first part. But the research may extend much further afield. Pathology is the study of life under abnormal conditions, and as such, and regarded simply as a branch of biology, is as worthy of study without any relation to the clinic or to man as is physiology. Some of the greatest advances which have been made in pathology have come from those who have attacked its problems from this point of view. It is possible that some of the pathological conditions in single cells will become much clearer to us from the study of cell charges in the unicellular organisms. The pathological laboratory should be provided with aquaria and with means for the study of vegetable pathology. The latter study has yielded most important results and has helped us to understand many things better. It is needless to say that in such a laboratory comparative pathology should have an important place. The science of comparative pathology has attained such an importance that it has its own laboratories and men who are exclusively devoted to it. The diseases of animals are now much better known from the anatomical and bacteriological point of view than they are from the clinical. Nothing

can be gained but much lost by such separation of comparative and human pathology. Comparative pathology has made and is making great advances. Investigations in it have been of great influence in the economy of the farm and country. By means of it many things in human pathology have been cleared up or the way for further investigations pointed out. The pathological laboratory then should afford opportunities for those who wish to work in any department, and whose training has especially fitted them for certain lines of work.

In what relation does pathology stand to the medical student? We may start with the assumption that the student is to be taught those things which will enable him to practise his calling, and that medical education is certainly the best which will produce the best practitioner. Probably the greatest fault to be found in medical education at the present time is that with the greater extent of ground which it covers and with the greater specialization of departments there is a lack of organic connection. The student learns anatomy, chemistry, physiology; he passes his examination on these subjects, and they more or less pass out of his life and memory. On his first entry into the clinic he begins the study of conditions which seem utterly at variance with what he has learned before. He finds on ausculation of the heart of an individual that in the place of a short, sharp, second sound, there is a murmur almost comparable to the water rushing along a pebbly brook.

In the place of the normal slow increase in the size of the artery at the wrist he feels a sudden sharp increase in size, then as sudden a collapse. He looks at the nails and sees that they first blush then pale. He is told that this condition is due to a regurgitation of blood at the aortic orifice, and he cannot see how his study of the normal circulation helps him in appreciating the condition here. If he is to understand the disease he must go much farther. He must understand how under the influence of a certain cause or causes a pathological process has been started in the valves and has led to a certain alteration in structure, called a lesion. That this lesion is the result of an inflammation in a tissue of a certain anatomical structure, and that in consequence of it the structure of the valves has become so altered that they can no longer perform their physiological function. His knowledge of the normal circulation tells him that the aortic valves should close tightly after systole, and how this is brought about, that the blood pressure in the arteries rises at each systole and slowly falls, the arteries emptying into the capillaries. It is only by comparing the normal structure with the abnormal, the normal function with the abnormal, that he is enabled to understand how the abnormal sound is produced and what it means. He must go farther, he must understand what compensation there is, what other changes have taken place which have made it possible for the circulation to continue in spite of such an abnormal condition. He finds that the heart is hypertro-

phied and dilated, and that at once brings him to the question of why and how this takes place. He must understand what effect this condition has had on the blood pressure, and to do this he may resort to experiment. What effect has this abnormal condition of the circulation had on the general blood-supply of organs and their nutrition? In certain cases he finds that in individuals with this lesion, the skin of the ankle pits on pressure; that the character of the urine is changed. He may recognize by a closer observation of all the clinical phenomena that in certain cases the active process by which the lesion is produced is still in progress, while in others the lesion is completed. In connection with the cause comes the action of bacteria. If he understands the disease it is necessary that he recall all he knows of physics, anatomy, physiology and pathological anatomy; all these bear on the case as soon as he begins to study the lesion and the effect of this in producing the abnormal function. Or he finds at the clinic that a patient presents himself with a swelling at a certain part of the body. He endeavors to distinguish by palpation whether the swelling is due to an exudation in the interstices of the tissue, or to the dilatation of an artery or to a new formation of tissue. He cannot learn this by being told that an exudation gives a certain sensation to the hand, an aneurysm another, a neoplasm another. He must know why this is the case, and the "why" again recalls all his previous knowledge. If the swelling be due to a neoplasm, he must

know not its name but its character, why in the one case a simple excision is all that is necessary, and in another that the tissue must be removed from far around the tumor together with all the lymph glands connected with the part in which it originated.

Pathology serves this most important purpose, that it serves to connect the so-called theoretical branches of medicine with the so-called practical. The student gets a broader point of view, and when this is once acquired it serves him as a basis for his reasoning powers. Moreover, the student learns in the study of pathology the methods of investigation of disease. If he is to practise his profession in any other way than as a day-laborer, he will constantly meet cases which present to him new features. He must know how to make a post-mortem examination himself, and must know how to appreciate the relation between the anatomical lesions and symptoms. He must learn to investigate the causes of the conditions which he has found. If he is to become a teacher in any department of medicine, it is necessary that he should acquire the broader point of view, and the methods of reasoning which come from research combining clinical phenomena and anatomical changes. With regard to how the student shall be taught pathology, there are many questions to be considered. Laboratory instruction combined with experiments and demonstrations should form the basis of his instruction. He should be taught first those general pathological processes on which

anatomical alterations depend and their causes, how the anatomical structure of an organ may modify the character of the lesion. Lectures are necessary to amplify what he has learned in the laboratory. Demonstrations should have the end of showing him what changes are produced in man by such processes. If possible, he should study with the demonstration the microscopic changes which have produced the gross appearance. In his laboratory course the student should thoroughly study one disease. He should inoculate an animal, study the clinical course of the disease, the lesions and their mode of production, and the relation of the lesions to the clinical phenomena. In an ideal course on pathology the student should have the opportunity for pathological work throughout his third and fourth year, when clinical instruction is given the most attention. He should during this time have a place in the laboratory where he can under some supervision carry on more or less independent work. He should have the opportunity to make for himself examinations of sputum, urine, blood, etc. Having followed a case through its clinical course and through the autopsy, he should have the opportunity to study for himself the lesions in connection with the clinical phenomena. It is only in this way by keeping constantly in his mind the connection between the lesion and the clinical phenomena of disease that the student appreciates that pathology is not the study of macra- or microscopic changes in organs but of life under abnormal conditions.

ARTICLE XLI.

SOME MODERN METHODS OF THE TREATMENT OF PHTHISIS, AND ITS SYMPTOMS.

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READ JUNE 8, 1898.

SOME MODERN METHODS OF THE TREATMENT OF PHTHISIS, AND ITS SYMPTOMS.

THE awakening interest in the treatment of phthisis so evident at the present time throughout the medical world is inspired, I think, by two facts; first the establishment of the unity of the disease through the discovery of the tubercle bacillus, and secondly a deeper realization of its curability.

Both pathological and clinical evidence afford abundant proof that pulmonary tuberculosis is susceptible of cure by nature either assisted or unassisted by art. This fundamental fact, clearly and fully realized, has stimulated the profession to study anew the causes and conditions of the disease, the means of its prevention, and its treatment when existing. Of its causes and prevention I have spoken elsewhere.* It is my purpose in this paper to outline some of the modern methods of treatment, which at present produce the best results.

As the two factors, the infecting germ and a favorable soil, must co-exist to produce the disease, so the treatment has consisted either in attempts to destroy the tubercle bacillus or imprison it; or in transforming the favorable into an unfavorable soil; or a combination of these two lines of attack. All attempts made to destroy the bacillus in situ have thus far, as we know, proved futile. What serum therapeutics may accomplish in this disease in the future we cannot say, but the anti-toxins have produced

* The Pray prize essay of the New Hampshire Medical Society for 1897.

such brilliant results in other infectious diseases that we may be hopeful that eventually the tubercle bacillus may meet its fatal foe from some such source. Meanwhile, we have the other line of attack left us, viz.: to develop and strengthen the resisting power of the consumptive until his pulmonary tissue presents no longer a favorable soil for the infecting germ. This is the plan universally adopted by the leading phthsio-therapeutists both here and abroad, and it has produced the best results yet attainable. It is all included in "rest, extraordinary feeding, and a life in the open air; mental and bodily rest,* overfeeding of a fearless and heroic description, and perpetual fresh air."

The bare statement of this method makes it seem simple enough, but the detail of its accomplishment, however, demands strenuous exertion, a determined will, and great patience both on the part of the patient and the physician. An exact and rigorously adhered to plan of life is required, and nothing must be left to chances or the caprice of the patient. I believe it is always best to tell him plainly his condition, and the treatment demanded, and thus obtain his coöperation in our efforts. He must realize that whatever in his former habits interferes with the new plan must be abandoned. He is like a settler in a new country; a new life and environment is before him requiring changed life habits, and he is to realize that not what enters into his body medicinally is to have much effect upon his disease, but what goes in as food and air is mainly to decide the issue.

The best results from this hygienic-dietetic treatment are undoubtedly obtained in closed institutions or sanatoria, in whatever climate they are situated, because in such institutions the management of the patient's life can be more exactly and continuously affected when constantly under the eye of the physician; and further, he has the advantage

* Treatment of Consumption: Harris & Beale. 1895. pp. 376-79.

of the equipment there existing for the special treatment of this disease. Much, however, can be accomplished outside of a sanatorium even at the home of the patient, and when he is compelled to follow some occupation. The main elements entering into the hygienic dietetic-method are:

I. Out-door life in a pure air, free from dust and smoke.

II. Abundant alimentation, consisting of properly selected and prepared food, rich in fats and carbo-hydrates.

III. Rest or exercise, or both according to the individual condition.

IV. Hydrotherapy. And supplementary to these:

a. Such general medication as from time to time seems to be useful in coöperating with the above measures.

b. Symptomatic medication, to relieve any symptom which interferes with the general plan, and which cannot otherwise be removed.

(It is well to repeat that all medication is simply subsidiary to the open-air and food treatment, and occupies the place of least importance.)

The open-air treatment is such a radical departure from the former notions regarding the management of the disease that it is difficult at first to convince the patient and his friends of its importance, and the thoroughness of its execution, as well as to disabuse him of his fears of such constant exposure to the weather. Not an hour or two a day out of doors on pleasant days is meant, but whole days, and day after day are to be spent in the open air, in cloud or sunshine, warm or cold, stormy weather alone excepted; and at night the windows should always be open in the sleeping room. This cannot all be accomplished at once, especially with those who have been accustomed to an indoor life, as have most consumptives. They must be gradually hardened and trained to it; an hour or two a day at first, and on pleasant days. Gradually these out-of-door exposures can be increased and less regard paid to the

weather and variations of temperature, until there will be but few days unavailable for the treatment.

The question naturally arises as to the climate in which this plan can be pursued. Are not especial climatic conditions necessary? and are we not obliged to send our patients away to find them? Of course some climates are admittedly more favorable than others; as, for instance, those of the high altitudes, which possess especially desirable characteristics; but, as Dettweiler says, "in the treatment of phthisis there does not exist either specific means or specific climate. Phthisis is curable everywhere, in every climate." Wherever one can obtain pure air free from dust and smoke, protection from sharp winds, and a fair number of sunny days, there the free-air treatment can be carried out, and outside of the cities and manufacturing towns one can almost anywhere in our State find these conditions. "Even in the midst of large towns," as Weber says, "the air in open spaces and even in the streets is very much purer than within the houses." Moreover, such a dust free atmosphere utilized in a methodic and continuous manner will produce results, I believe, comparing favorably with those in the well known so-called health resorts. The climate of Falkenstein, for instance, possesses no very great advantage over that in many portions of New England; it is variable, has frequent rains, and the proportion of sunshiny days throughout the year is not extraordinary; and yet the results obtained compare favorably with those of other sanatoria more advantageously situated climatically. The secret is in making the most of such climatic conditions as are available, and thoroughly realizing the inestimable value of pure air in the treatment of phthisis. "If indeed pure air," says Dr. Henry MacCormac, "were a thing of price, of fictitious price I mean, for otherwise it is priceless; if people had to dive for it into the sea depths, or grovel for it in the mine, then would they value and

appreciate it." The effect of the open-air treatment is striking; there is a gradual reduction of fever, a gain in appetite and weight, sleep is improved, and night sweats diminished; cough, which may be temporarily increased, is in the end lessened, and there is a sense of comparative well being, and improvement of spirits. I am well aware that in private practice it is far more difficult to establish and maintain this open-air treatment than in the sanatoria arranged for the purpose, but with a little ingenuity and persistence it can be approximately accomplished, I believe, in most cases.

As the life in the open air must be principally one of rest, some spot must be selected, perferably facing the south, where the patient can recline upon a deck or reclining chair, and be protected from the wind and rain,—for a moderate rain does not contra-indicate the treatment. A veranda with movable curtains at the sides; a small light wooden hut or shed, that can be easily transferred from one place to another, and turned around according to the direction of the sun or wind; a tent with a raised wooden floor, and curtains capable of being open or shut; an awning on a house-top; a hammock under the trees, are some of the contrivances by which this may be accomplished. The environment of each individual case will suggest others. The recumbent position is preferable for several reasons: the feet and legs can be better protected with wraps, and even hot water bottles in cold weather; the circulation of the blood in the lower extremities takes place more easily, and, according to Volland, the blood supply to the apices of the lungs is increased, thus favorably influencing the nutrition of the diseased parts. As one becomes habituated to this open air exposure, he will pay less regard to variations of temperature and but few weather conditions will prevent it. In the continental sanatoria it is carried out in summer and winter, in rain and snow; high winds being almost the sole

weather contra-indication. The question might be asked why is not a large well ventilated room with an open window as good? A moment's reflection, I think, will satisfy one that a patient cannot be so continuously bathed in fresh air indoors as out, even in the best ventilated room —the one is aeration, the other hyper-aeration. Then again the out door air is purer than it can be in any living room.

I have said that the life of the consumptive out of doors must be principally one of rest, and this is especially true at the beginning of the treatment. The general system is in a depressed condition, the circulation poor, and the heart inadequate for its work. Rest, mental and physical, and abundant and nutritious food, with as little expenditure of vital force as possible, are the measures indicated, and will best aid in forming fat and blood. Much exercise is a mistake, I believe. The experience of the Dettweiler system of uninterrupted rest, continued for months, has abundantly vindicated its value.

With febrile cases rest should be the invariable rule admitting of few exceptions; for experience has proved that rest either in the open air or in a well-ventilated room with open windows is the quickest and most certain way of subduing this symptom. At the sanatorium of Hohenhonnef the fever patients are not even allowed to lie out in the reclining chairs for fear the moving might aggravate the fever. This matter of absolute rest for febrile cases of phthisis I have seen so often disregarded that I desire especially to emphasize it. When the fever is intermittent, and the morning temperature is normal, a limited amount of exercise may be advisable, but such cases should be under careful observation. Afebrile cases can, as a rule, take a certain amount of exercise, depending largely upon the condition of the heart. This should not be so severe or prolonged, however, as to exhaust the patient or produce dyspnœa or excessive perspiration. The kind of exercise

will depend somewhat upon the environment and available conditions, but walking either on the level, or up gentle ascents—Brehmer's "hill climbing"—is the simplest and most free from injurious effects, and can, moreover, be easily regulated. The physician should determine the amount and not leave it to the judgment or caprice of the patient.

Whatever form of exercise is adopted, deep breathing or lung expanding movements should constitute a part of it. The "breathing tube" is serviceable for this purpose, permitting a free full inspiration, and an impeded, gradual expiration; or one may simply stand erect with the hands on the hips and take slow, deep respirations. The chest expansion may also be assisted by arm movements in either the erect or recumbent position. As with all else connected with the hygienic-dietetic treatment, these breathing exercises should be taken regularly, so often, and so many times. Of course, if the discretion of the patient can be relied upon, various other forms of gentle exercise, depending upon his condition, may be useful as combining with the exercise pleasurable diversion, or in the form of some light occupation, such as gardening, driving, or other work upon the land. It must be borne in mind, however, that all this applies to afebrile cases.

If the impossibilities of establishing an out-door life at or near the home of the patient, appear insuperable, which I believe will not be so often the case as one might at first think, then a change of residence is demanded which will render this attainable. Wherever the patient goes he must be under careful and constant medical supervision and be thoroughly imbued with the significance of the open-air treatment; however admirable the climate, it must be utilized to the fullest extent in order to realize its beneficent influences. Continuous out-door life is the only one for the comsumptive, for him it *is* life. This is not the

place to consider the different climates applicable to phthisis. I will only say that experience so far has proved that the medium or high altitudes have produced the best results, largely I am inclined to think because they afford the purest air; but it is well to repeat again here Dettweiler's words: that consumption can be cured in any climate.

FOOD.

Of equal importance with the air treatment is the feeding of the patient. "Air and food both of the best quality possible are the most potent factors in treatment." An abundance of nutritious, easy assimilable food, containing a due proportion of proteids and carbo-hydrates, and rich in fats, is required. Brehmer attached great importance also to all kinds of vegetables. Much attention must be given to the quality and preparation, as well as to the method and time at which the food is to be taken. There should be frequent variety, adapted to individual taste and condition, and the service should be such as to render it appetizing and attractive. Experience has shown that the amount of food required can be best taken by frequent small meals, generally five a day, arranged somewhat as follows: At seven or earlier, a glass of warm milk in bed or while dressing, with a spoonful or two of brandy or limewater if indicated. At 7.30 to 8, breakfast, consisting of tea, coffee or cocoa, bread and butter, bacon, fish, poultry or meat. At 10 or 11, a glass of milk or a cup of broth or beef-tea, or a sandwich and a glass of wine. At 1 or half past, dinner, consisting of soup, meat or poultry, or fish or game, with fresh vegetables and a light pudding or fruit. Also alcohol in some form may be allowed at this meal, if the physician considers it desirable. At 4 o'clock, a glass of milk or a cup of tea or coffee with much milk, or bread and butter or rolls. At 7, supper, with one or two courses, and vegetables, similar to the meal in the middle of the

day. At 9 or 10 on going to bed, a glass of milk, or bread and milk, or milk with some farinaceous food like oatmeal porridge. If milk alone is taken at this meal two or three teaspoonfuls of brandy may be put in it. In pyrexia the nourishment must contain less solid food and be taken more frequently. It is not enough to dismiss the matter of diet by telling the patient to eat all he can of good food; in that case we may find he is taking but very little nourishment, his appetite may be lacking, the digestion impaired, so that at the time when he most needs to be fed we shall find he is taking the least food. We may aid the appetite and digestion by some temporary simple medication, although generally the out-door life will prove the best tonic. By persuasion we can induce him to take a little, and this will increase the desire for more. Sometimes we must insist that a stated amount of food must be taken. The fancies of the patient can sometimes be followed to advantage. Good cooking and attractive service also aid materially. By ingenuity, constant attention and insistence, and frequent and small feedings, we can generally succeed in having our patients take a liberal amount of nourishment, a much larger quantity than at first seemed possible. It is well to bear in mind that the digestive powers of a consumptive are often greater than the appetite indicates. Periodic and frequent weighing of the patient will indicate the success or failure of the method of feeding adopted.

Milk, either as such or in the form of koumiss or kefir, or when it constitutes the principal ingredient in some of the various "foods", is a most valuable adjunct to other kinds of nourishment, and in certain conditions, such as gastro-intestinal disturbances, may form the entire diet. It can be made more digestible and agreeable by adding soda or some of the various alkaline mineral waters, such as seltzer or apollinaris, or a small amount of brandy; or a small quantity of coffee, tea or cocoa will render it more palata-

ble in some cases, while in others it is best borne peptonized. Care should be taken that it is obtained from tested cows, or if not it should be boiled. When used with other forms of nourishment four or five glasses a day will be enough. In the so-called "milk cure," when it is the exclusive article of diet, as much as ten to twelve glasses are taken in the twenty four hours. Its true office, however, I believe, is to supplement the regular diet.

Alcohol may be regarded either as a food or a drug, and practically it makes little difference how we look at it. Of its value in the majority of cases I am convinced, especially when fever exists. The method of administration and the daily dose must be determined by individual conditions. Regarding the form in which it should be used, it does not make so very much difference in my opinion. Dettweiler has a predilection for brandy diluted with water or milk. Whiskey can be used in the same way. Various wines, heavy or light, Hungarian, Port, Sherry, Tarragona, Rhine, Italian or California, can be used with the meals. Brehmer does not consider beer as adapted for consumptives. When the appetite is wanting, digestion enfeebled, the circulation poor, and pyrexia exists, alcohol in fairly large quantities is indicated, if it can be taken without discomfort, and will alleviate in a marked degree these symptoms. With patients, however, who rapidly increase in weight and blood tension, alcohol increases the liability to hæmoptysis and is also dangerous for those who show a disposition to hæmorrhage.

Cod liver oil, which is sometimes classed with foods, sometimes with drugs, is, by a vast experience in its use, acknowledged to be the most valuable single nutritive agent in all the consumptive's dietary. "I have no hesitation," says Dr. C. J. B. Williams, "in stating my conviction, that this agent has done more for consumption than all other means put together." Of all the fats it is the most

easily digested and assimilated, and can be tolerated by the majority of patients, and for long periods of time, if one begins its use cautiously, one or two teaspoonfuls a day. Wherein its peculiar efficacy resides, whether in the oil itself or something contained in it, is still undetermined. It seems reasonable, however, to suppose that the inorganic substances and biliary salts which it contains, are largely influential in its easy digestibility and absorption, and hence rendering it more nutritive than any other fat food. At all events it is surely a fact that a patient will gain weight from cod liver oil when he can do it in no other way. Daremburg and others consider the darker colored oils more efficacious than the pale; the latter, however, are generally prescribed. The majority of consumptives can take cod liver oil with benefit. There are, however, some contra-indications, gastric or intestinal catarrh, diarrhœa, and fever if high or continuous. When there is only a slight rise in temperature in the evening, a moderate dose can generally be taken. It is most valuable in the quiescent periods, and the least so or even sometimes harmful, in the active, when the degenerative changes are rapid. I always give it, if possible, alone, either directly after meals, or in two or three hours. It can be floated upon milk, coffee, whiskey, brandy, ale, porter, or lemon juice. I have recourse to the emulsions only as a last resort.

The various malt extracts, so extensively used now, have a certain limited value, if not exactly as food, as an aid to digestion, and as a very useful vehicle for cod liver oil. Of course they bear no comparison in value to the latter.

Hydrotherapeutics, which occupies an important place in the hygienic treatment of phthisis in foreign sanatoria, does not seem to have been generally appreciated in this country, at least in private practice. By the hydropathic treatment the body is hardened, thereby giving it greater protection against cold; the circulation is accelerated and strength-

ened; the appetite stimulated; and tissue metamorphosis promoted. It is used symptomatically in pyrexia, night sweats and various nervous phenomena. It consists of warm baths, ablutions, cold friction or sponging, the wet pack, and douches. Cold sponging is the simplest method, and if a chill is feared or the extremities are cold, the patient can stand in warm water and hold with both hands a hot pack to the pit of the stomach. (Ransome.) For cold friction the patient stands near the bed, stripped, and is wrapped in a sheet wrung out in cold water; the whole body is then rubbed firmly and rapidly; the sheet is then removed and a dry one folded about him, and he is rubbed again, and then dresses quickly. The cold friction may be partial and applied while the patient is in bed.

The wet pack is applied while the patient is lying upon a bed covered with a blanket. A coarse linen sheet is wrung out in water of a temperature of from 70° to 50° F., and tucked about him and this covered with a blanket. In this he remains from one-half to an hour, and it is well to have a window open while he is in the pack. Instead of the full pack certain portions of the body only may be included, as the trunk, the upper half, or the limbs. The end to be attained by the wet pack is to stimulate the skin activity and thereby relieve the congested thoracic organs.

Chest compresses consist in the application of napkins wrung out in cold water and covered by flannel. The Winternitz cross band is extensively used upon the continent in phthisis, and is said to relieve and lessen the cough, favor expectoration, and improve the respiration. It is applied by winding about the chest from one axilla to the opposite shoulder and reverse, a linen cloth or sheet wrung out in cold water, until the whole chest, front and back, is covered, and then applying in like manner a dry flannel cloth. The cold douche, only applicable to mild cases with fairly good reactive power, consists of a rain or cascade

douche from above, or a hose with a jet or sprinkler from the side. This is generally used in the morning under the immediate supervision of the physician, beginning with five seconds and gradually increasing to not more than forty. The patient is then rubbed dry with a rough sheet.

Ablutions can be applied to all patients, and consist in bathing the body especially the chest, front and back, with a sponge wet in water at the temperature of the room, and then rapidly drying it with a rough towel or horse-hair glove. In the case of night sweats, diluted spirit or vinegar may be substituted for pure water. Ablutions are given in bed and generally in the morning. When the patient is feeble or neurasthenia exists, massage is useful.

In the hygienic treatment the clothing demands consideration especially while the hardening process of out-door life is being established. The tendency, not to say danger, is in wearing too much and too heavy clothing, especially about the chest. The capillaries of the skin are relaxed, excessive perspiration induced, thereby rendering the body surface more sensitive to changes of temperature. The under garments should be loose enough to allow a layer of air beneath them. "Inside our dress," says Pettinkoffer, "we should carry the air of the South wherever we may be * * * We live in our dress like an unclothed tribe in a Paradisian country, where the air is constantly calm and the temperature from 75° to 94° F." Experience has proved that the innermost garment should be of wool of a weight adapted to the season, of light open texture, and loosely fitting. (Ransome.) Chest protectors belie their name and are a source of danger by rendering the skin of the chest more sensitive. "The best chest protector," says Ransome, "consists in well douching the chest night and morning with quite cold salt water."

Under general medication I shall speak only of Creosote, the Alkaline Hypophosphites, Strychnia, Arsenic, and Iodoform.

Creosote, known in the days of Louis, and of late years popularized by Sommerbrodt, is perhaps as extensively used at the present time as cod liver oil. No drug could have retained its hold so long without possessing intrinsic value. Opinions differ as to its action; the extremists hold that it has a specific effect upon the disease and its bacillus; the conservatives, on the other hand, believe its value consists simply in improving nutrition and thereby increasing the resisting power of the individual. "It has the power," says Whittiker, "of destroying the lower organisms, especially those of fermentation, hence the undeniable virtue of creosote is chiefly nutritional." All who have used it to any extent in phthisis can bear witness to the fact, that the cough and expectoration are lessened, the weight increased, and the appetite, digestion, and general condition improved. It is contra-indicated in gastric or intestinal catarrh, fever and hæmoptysis, and where it appears to injure rather than to improve digestion. The dose varies with different practitioners, and whether they hold one or the other theory regarding its action. Those who believe in some specific action give large doses, sometimes as much as a drachm three times a day. I begin with one or two minims and gradually increase to ten, not as a rule going beyond that. I use the plain beachwood creosote giving it in milk, cod liver oil, malt or wine, or with Gentian or other aromatics, and continue its use for months. Guiacol, a derivative of creosote, has essentially the same action as the latter; it has nothing to recommend it above creosote except its less objectionable taste, and its being somewhat less irritating to the gastric mucous membrane. Carbonate of creosote (creosotal) has lately come into extensive use and is said to be the most eligible preparation of the drug, being free from its nauseous odor and burning taste and less likely to cause gastro-intestinal disturbance. Seifert* gives

* Lancet, April 2, 1898.

the following method of using it in Leyden's wards in Berlin. Beginning with a dose of 5 drops, and increasing 3 drops daily, a maximum of 25 is reached and continued from one to four weeks, or even longer. The dose is then diminished in a similar ratio to 10 drops and then eventually the ascending scale is begun again. Used in this way it is said to be cheaper than creosote. Whichever one of these creosote preparations is used, it should not be used blindly, and when digestive disturbances are excited, or no symptomatic or general improvement is apparent, it should be discontinued.

The alkaline hypophosphites in this country and England at least, are very extensively employed in phthisis, particularly in its earlier stages and with the young. There is no evidence that they exercise any specific influence upon the disease, but their chief effect seems to be in improving appetite and nutrition and allaying nervous excitability. They also influence favorably night sweats. Daremberg* says that there is a great loss of phosphates from the bodies of phthisical persons in the sputum and urine, and further, that the calcareous masses found in the lungs are chiefly phosphates and carbonates of lime and magnesia; hence he thinks that the hypophosphites are of value in aiding the formation of fibrous tissue which contains much phosphates and carbonates, and in producing calcification of tubercle by furnishing to the organism one of its constituent elements. Hodgkinson† is also of this opinion, especially when the disease is local and quiescent, and thinks the efficacy of the hypophosphites is enhanced by using them in conjunction with cod liver oil. Whether anything of this kind actually happens seems to me doubtful; probably the chief, if not the only value of the hypophosphites is in promoting nutrition. In pyrexia they are contraindicated.

* Ransome. The Treatment of Phthisis. 1896. p. 153.

† Ransome. loc. cit.

Strychnia I have used extensively, and it has seemed to me to be of more than ordinary value, not only as a tonic to the digestive system, but for its general effect upon the heart and respiration. Mays * considers this drug next in importance to physical rest and nutritious food and gives it in heroic doses, from $\frac{1}{32}$ to $\frac{1}{4}$ of a grain at a dose; he refers to one patient who took $\frac{1}{6}$ of a grain four times a day uninterruptedly for two months. Dr. C. J. B. Williams, † late of Brompton Hospital, says that strychnia may be regarded as a specific against the retching of phthisis, and he gives it in doses of from $\frac{1}{32}$ to $\frac{1}{24}$ of a grain. By the use of this drug, he says, patients have been able to persevere with cod liver oil for months and even for years without digestive derangements.

Arsenic only has value in this disease as a useful tonic in aiding nutrition and stimulating assimilation. There is no evidence for regarding it as some observers have done, as an anti-bacillary medicine. The French physicians are unanimous in ascribing to it exalted value. "It would be difficult," says Jaccoud,‡ "to find an agent more capable of resisting the consumptive tendency which exists in every form of the disease." Its value, Jaccoud says, depends upon its power of combatting malnutrition always existent in the disease. C. J. B. Williams considers arsenic the most useful tonic next to strychnia, checking slight pyrexia and night sweats and improving the respiratory powers. It is best administered after food.

There is but one other drug I shall refer to under the head of general medication, the extensive use of which would seem to warrant its mention; it is iodoform, either used as such, or in the form of its substitute europhen. So far as evidence has accumulated regarding it, its chief

* The Strichnine Treatment of Pulmonary Comsumption. 1894. Reprint.

† Pulmonary Consumption. Williams. 1887. p. 391.

‡ Curability and Treatment of Pulmonary Phthisis. p. 144.

effects appear to be an improvement of the appetite, increase in weight, and a diminution of the cough. Ransome, who is careful in his statements, says he believes it is one of the best of the medicines that can be given for the purpose of assisting nutrition and alleviating cough. Flick applies europhen by inunctions, using the following formula:

℞	Europhen	ʒ i.
	Oil of Rose	gtt. i.
	" " Anise	ʒ i.
	Olive Oil	℥ iiss.

M.

Rub about a tablespoonful thoroughly into the inside of the thighs and into the armpits before retiring at night. If the odor is objectionable the patient can be sponged with bay rum in the morning.

When one considers the limitations of the few remedies above enumerated, the best of the thousands which, at one time or another, have been suggested and used in the treatment of phthisis, he must attest the truth of Lænnec's conclusion "that although the cure of tuberculous phthisis is possible for nature, it is not so for medicine."

I have purposely refrained from referring to the therapeutic use of tuberculin and its derivitives, both because the subject has recently been presented to this Society,* and also because in this paper I desire to present such methods as are more easily and universally applicable and have been longer tested. Although I am hopeful as to the future possibilities of tuberculin, I do not believe its uses and limitations have been as yet sufficiently determined to warrant dogmatic statements. In passing I will say that my experience with tuberculin for diagnostic purposes has satisfied me that it is a most valuable test, and, when used in proper doses, without injury to the patient.

* Vide Dr. Worcester's paper before this Society, 1896.

Under symptomatic medication I shall refer to the fever, sweating, cough, hæmoptysis, digestive disturbances, and vomiting.

Fever may exist at any stage of the disease, either when the infection, so far as we can tell, is a pure tubercular one, or when the mixed infection has taken place and the fever is that of sepsis. It has been maintained that a pure tubercular infection is afebrile, but the evidence does not seem to corroborate this view, for we have fever when neither the streptococcus, staphylococcus or other micro-organisms other than the tubercle bacillus are found. This symptom is of extreme importance both as regards the prognosis and treatment, for so long as fever exists we know that the disease is active and improvement as a rule cannot take place. In this disease as in most others accompanied with fever, one must bear in mind that fever is one of the results of the general disease and not a disease itself, and consequently our efforts must be directed to the disease and not primarily to the fever. In the majority of cases the fever which we meet with is of the septic or hectic kind of a remittent or intermittent type, reaching its highest point in the latter part of the day and its remission or intermission in the morning, although this curve may be reversed. It is generally accompanied at one time or another in its course by night sweats and chills. The effect is the same as in other septic fevers, a loss of weight and strength, impairment or loss of appetite and various nervous phenomena.

The treatment, as I have said, is one directed to the general condition, hygienic, rather than medicinal. Rest of body and mind in a pure, dust-free air, and good and easily digested nourishment. By this means, Schröder, of Hohenhonnef, says he has succeeded in reducing the temperature to normal in a large number of cases, and in putting the patients into the category of those who endure their tubercular infection without rise of temperature. Rest

should be the absolute rule for fever patients, as I have already observed. Of course there are individual exceptions, for individualization must always be made in this disease. Where a long confinement is evidently doing more harm than the fever, the appetite and digestion are failing, and the courage waning, it may be the least of two evils to allow the patient to move about a little, especially when for a certain portion of the day the temperature is nearly normal.

The food in phthisical fever should be abundant and rich in fat and carbo-hydrates. It should be carefully and delicately prepared, and given in small quantities and frequently. If the appetite and digestion fail a liquid diet may have to be resorted to, composed largely of milk, either plain or in the form of koumiss, kefir or peptonized. As I have said above alcohol is indicated, a glass of strong wine or a teaspoonful of brandy in milk several times a day, especially when a chill is apprehended. Sponging with cool water or mixed with alcohol or vinegar night and morning; cold water compresses applied to the chest; an ice bag over the cardiac region if the heart is rapid, are some of the hydropathic measures of service. Antipyretics are only to be resorted to, in my opinion, when the other means fail and the fever causes annoying symptoms such as disturbance of sleep and the like. At the best they only exercise a very transitory influence, with more or less resulting depression. When used the choice may be either antifebrin, phenacetine, antipyrin or lactophenin. If the heart is weak, caffein or strychnia can accompany them. "Nothing in my practice," says Ransome, "has done so much to relieve the patients (of fever) as fresh air, and sponging with cold vinegar and water. Fresh air night and day before everything else."

A symptom intimately connected with, and so frequently dependent upon fever, is *night sweats*. We may, however, have excessive night sweats when the fever is very slight,

as in the early stages of the disease, or later on when it is of a mild type. In either case the ultimate cause is some disturbance of the central nervous system, probably toxæmic, acting either through the sweat centres or those of the vaso-motor system. When the sweating is an incident of the fever the treatment of the latter is the treatment of the former, and when one subsides the other will. When, however, the sweating is out of proportion to the fever, or it becomes an annoying and depressing symptom, especial treatment is indicated. Here again hygienic-dietetic measures are of most value. A good meal in the evening, and a glass of milk with two or three teaspoonfuls of brandy the last thing at night, repeated, if necessary, during the night, or if not this, some simple food; dry or moist rubbing with acidulated water at night, and compresses to the chest, all the while the patient being allowed an abundance of fresh air. If these means fail, drugs are the last resort. Strychnia is indirectly valuable as a tonic to the depressed nervous system. Of the specific anti-hydrotics, we have several, and I know of no means, except by trial, of determining which will succeed in any case. One after another has to be tried until the successful one is found. The most generally successful I have found to be camphoric acid, 30 grs.; picrotoxin $\frac{1}{100}$ to $\frac{1}{50}$ gr.; agaricin $\frac{1}{12}$ gr.; and atropia $\frac{1}{60}$ gr.; the order indicating their value. Agaricin should be given six or eight hours before the usual time of the commencement of the sweating, camphoric acid an hour or two before, and atropia or picrotoxin at bed-time. The patient should be well covered in bed with woolen blankets and sleep with open windows.

Of all the symptoms of phthisis, *cough* is the most constant and evident one. "If I can only get rid of the cough; give me something for the cough," is the oft repeated and pathetic appeal of the poor consumptive. In the first place the patient must be made to understand that

cough to a certain extent is necessary, and is to be promoted and favored. Beyond this necessary and conservative amount, however, there is the unnecessary, which exhausts the strength, interferes with nutrition and disturbs sleep.

By our management of the cough, two things are to be accomplished; to reduce to a minimum the amount necessary for the expectoration, and to stop the irritable unnecessary coughing. In the cough of expectoration one can learn to accomplish the results with the least expenditure of strength. The tendency to cough can be restrained until the expulsion of the secretion is easy or almost comes of itself. Exercise in the open air is said to facilitate this, when exercise is allowable, as well as pulmonary gymnastics. In the spasmodic cough unaccompanied by much if any expectoration, besides the control which the patient by training can exercise, various simple means will further aid, such as counter-irritation, a sip of water or milk, warm milk with salt, seltzer or apollinaris water, pastiles of Iceland moss or gelatine, gum arabic, a wet compress over the chest. The degree to which cough can be controlled by the training is admirably illustrated in the German sanatoria, where one sees a hundred or more phthisical patients together at dinner and hardly hears more coughing than would occur in an assembly of an equal number of well people. The coughing which occurs directly after eating rest in the recumbent position will sometimes obviate The common morning attack of coughing, one of expectoration, often so prolonged and severe, can frequently be modified in intensity and duration, by taking on awakening a glass of warm milk with a little soda or salt, or an alkaline drink, such as vichy, seltzer or soda, with a teaspoonful or two or brandy or rum in it.

Of medication, the one drug which I have found more serviceable than all others is codeia, and indeed I rarely use any other. I am accustomed to use it in the form of a

one per cent. solution. It does not disturb the appetite or digestion, or cause constipation as the other preparations of opium are likely to do; a couple of teaspoonfuls of this solution will generally give a good night's rest. "Again I would insist," says Ransome, "that fresh air and plenty of it is the best remedy for cough, especially when this is at all spasmodic in its character. Over and over again I have noticed the cough cease entirely as long as the patient was in the open air, and come on again on the return within doors."

Hæmoptysis occurs in about 50 per cent. of all cases of phthisis, and may happen and prove fatal at any stage of the disease. Jacobi speaks of having seen a fatal case in a patient who had never presented any symptoms, or been suspected of having any tubercular disease. Vascular tension and degeneration of the walls of the vessels are the two causative conditions, and it is evident that in treatment we can only expect to directly influence the former. There is a diversity of opinion as to how this can best be accomplished, and consequently a diversity of treatment. There are certain general rules, however, which are applicable to all cases. First, the patient must be maintained in a complete state of rest both mental and physical; this alone in many cases will suffice. Secondly, and as more thoroughly accomplishing the first, is the use of opium in some form, preferably morphia subcutaneously; by it the nervous excitement is controlled and the cough restrained. The general usage is to give the nourishment cold, as iced milk and the like. While not considering this necessary, it should be simple and unstimulating, and perhaps best in the liquid form. The value of external applications seems to me doubtful. The ice bag on the chest or over the cardiac region is the most common one, but its efficacy is questionable and it may do harm. Counter-irritation in the form of mild mustard plasters to the back and sides of the chest,

or dry cupping, seems more reasonable. Experience in the use of drugs varies greatly, probably because they have been used empirically rather than with a regard to the underlying pathological conditions.

In most cases of bronchial hæmorrhage what we desire to accomplish and all we can indeed accomplish is a lowered pulmonic vascular tension, and this we can affect by a general depression of the blood pressure as well as a reduction of the amount in the lungs. The means that serve for this purpose are—atropia, ipecac, saline laxatives, salt, and the application of constricting bandages to the extremities. In a case of moderate severity, where the pulse is of fair strength, I would outline the treatment as follows:

Complete rest, opium, salt dry on the tongue, a saline cathartic and aconite, or some other general vascular sedative according to the tension. If ipecac is used it should be given in sufficient amounts to maintain nausea. When the hæmorrhage is profuse, besides rest, opium and salt, ligature of the extremities and from $\frac{1}{50}$ to $\frac{1}{25}$ gr. of atropia subcutaneously are indicated. The atropia causes vaso-motor paresis, thereby diverting the blood to the periphery. When the obstruction in the lungs and the coagula in the upper air passages produce dyspnœa and cyanosis, threatening suffocation, attempts should be made to dislodge the clots from the larnyx, and champagne, ammonia, or other stimulants are indicated. If the hæmorrhage appears to be passive from cardiac weakness, digitalis and alcohol may be used. In the sudden and excessive bleeding in the latter stages of the disease, from the rupture of an aneurismal sac, nothing avails, and I have had a patient die almost before the nurse could cross the ward. I am doubtful if the astringents are of any great value, although they are perhaps oftener used than any other class of remedies, especially ergot. Those which appear to be the best for this purpose, if any are used, are turpentine in 5 minim capsules every 4 to 6 hours; oil

of erigeron from 5 to 20 drops or more, and the fluid extract of hydrastis canadensis, from 20 to 30 drops.

Chronic Dyspepsia is a common and annoying condition in this disease, represented by a variety of symptoms; failure of appetite, vomiting, heartburn, a fulness after eating, and other unpleasant sensations dependent upon digestive disturbances. The most important part of the treatment is the regulation of the diet, together with the open air life. Milk, either as such or in the form of kefir or koumiss, is always available and useful. Frequent feedings of small amounts of easily digestible food are indicated, broths, bouillon, eggs, chicken, meat extracts, fish, sweetbreads, oysters, preferably raw, various kinds of farinaceous food. Sometimes an almost exclusive diet of beef is best borne. Perhaps the food can be better taken cold than warm.

If there is a tendency to diarrhœa, two or three teaspoonfuls of brandy in milk and lime water may be given, or if on the other hand constipation exists some alkaline mineral water can be used to dilute the milk. If the digestive ferments are deficient in quantity or quality, peptonized foods are of service, together with nux vomica or some of the bitter tinctures and hydrochloric acid. When a catarrhal state of the stomach is present, indicated by a red tongue, pain after food, flatulence and perhaps nausea and vomiting—so frequent a condition in the latter stages of the disease—a little opium with bismuth, perfect rest after eating, moist compresses over the gastric region, are some of the remedies. If creosote is being taken it should be omitted. If there is fermentation, some of the intestinal antiseptics, guiacol, creosote, bismuth, charcoal and the like may obviate this symptom.

Vomiting is a symptom which demands our most careful attention, for it attacks nutrition at its source, and as Darenberg says, "the stomach is the stronghold of the consumptive, and alimentation the principal means of defence." It

occurs most frequently at the initial and terminal stages of the disease. It may be caused (*a*) by the cough directly, much as in whooping cough; (*b*) by reflex cough; (*c*) by abnormal gastric conditions, catarrhal and dyspeptic. When the cough is the direct cause, as when the patient arises from bed in the morning and has a paroxysm of coughing accompanied by retching and vomiting, the treatment of the cough is in a measure the treatment of the vomiting. But we cannot wholly prevent the cough, nor would it be wise to do so, for it is often one of expectoration. In a large number of these cases it has been found that pharyngeal hyperæsthesia* exists, and the irritation of this sensitive area in the throat either by the cough or expectoration excites a momentary reflex nausea terminating in vomiting. If then we suppress this hyperæsthesia we stop the vomiting, and this can be accomplished in the majority of cases by applying to the pharynx a solution of cocaine by spray or brush.

Food passing over the hyperæsthetic throat may also produce the same phenomena, viz.: cough and vomiting; and here the application of the cocaine should be make just before eating. Vomiting from reflex cough, occurring during or soon after taking a meal, is attributed either to the presence of food in the stomach through irritation of the gastric terminals of the pneumogastric, or to an increased secretion in the air passages caused by the stimulus of the circulation produced by the food, or, as Berthier thinks, from the same cause as the former kind, pharyngeal hyperæsthesia. At all events, the throat should always be examined in these cases and treated if the condition exists. If the first cause appears to be the dominant one, primarily very careful attention must be given to the feeding. The food must be taken in small quantities, sometimes limited to liquids, sometimes to solids, and slowly and thoroughly

* Berthier, Renne de la Tuberculose. 1898. p. 1.

masticated. Gastric sedatives are also indicated: a few drops of laudanum in water, codeia, bismuth with three or four drops of diluted hydrocyanic acid, tr. of iodine from 1 to 10 minims, chloroform water shortly before meals or strychnia an hour before, and after eating a few drops of hydrochloric acid in water. Oxalate of cerium, the bromides or creosote may also be tried, if other means fail. A glass of warm water at the beginning of the meal, or a little brandy or whiskey diluted with some mineral water during the early part of the meal may also be of service.

When the exciting cause seems to be the increased secretion in the air passages from the stimulus of the food, free expectoration is to be promoted and the air passages cleared before the taking of food. This may be accomplished by a warm stimulating drink half an hour before the meal, a cup of hot milk with some alkaline water and a teaspoonful or two of brandy or whiskey, or beef tea or broth with a teaspoonful of brandy. The meal is then to be a dry one and a little pepsin and hydrochloric acid taken after it. If, in spite of treatment, vomiting ensues it is advisable to try a little food immediately after. If the vomiting is caused by definite gastric symptoms, these should have their appropriate treatment, as indicated under the head of digestive disturbances. When the vomiting persists in spite of all treatment and a fatal issue seems imminent, or the patient is becoming rapidly emancipated and enfeebled, the last resource is opium freely used.

In the treatment of phthisis the physician must gird himself for a long, hard, persistent struggle and be prepared for many a reverse, but success comes frequently enough to inspire him with courage and hope. To have snatched a single life from the grasp of this relentless monster is a source of infinite satisfaction.

ARTICLE XLII.

TYPES OF HABIT NEURO-PSYCHOSES.

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TYPES OF HABIT NEURO-PSYCHOSES.

THE excuse for bringing to your notice a subject by no means new, is its extreme but too often unrecognized importance. In the same sense that habit forms so essential a part in the normal conduct of our daily lives must we look upon it in those conditions which, while bordering on health, often lead to disturbances of nervous equilibrium, which are distinctly pathological. It is the transitional period which is important, and demands our special attention, that critical period when a neural process once gone slightly astray is as likely to go on to the formation of a confirmed morbid habit as to return to the bounds of what we commonly term a normal state. Our attitude toward the victims of such perverted nervous habits is often tolerant, but rarely truly sympathetic and analytical as toward the less subtle forms of disease.

The object of this paper is to bring to your notice a number of conditions, illustrated by certain typical cases, which deserve our profound study and closest analysis. In attempting this we are repeating what has already been admirably done in Boston by Dr. Morton Prince* and Dr. Russell Sturgis,† whose papers, in great measure, have afforded the stimulus for this reiteration of the general principle involved. Prince's paper on "Association Neuroses"

* Prince: Association Neuroses, etc. Jour. Ment. and Nerv. Dis. 1891, XVI. p. 257.

† Sturgis: Use of Hypnotism to the First Degree, etc. Med. Record, Feb. 17, 1894.

appeared in 1891. It is an altogether convincing presentation of the significance of association or habit—to use a less technical word—in the genesis of many affections which, when established, have the traits of independent diseases. Dr. Sturgis has approached the subject from a somewhat different point of view, but likewise offers much that is suggestive.

It is evident to the most superficial student that in the genesis of the common neuroses we are dealing with matters, whose proper interpretation demands the exercise of our most critical judgment. Neurasthenia, for example, has far outgrown the interpretation put upon it by Beard. Fatigue is by no means always an adequate explanation; the sympathetic nervous system is demanding a recognition not yet accorded it; the subtle problems of food supply to the neuron, and nutrition, in the broadest sense, are claiming their share of attention. The mental factor is again becoming prominent. The time has, in fact, come, when our conceptions must be remodelled on comparatively new lines. It is, however, not at all our purpose to attempt the discussion of any of these disputed matters, but simply to limit ourselves to the interpretation of certain symptoms by means of an appeal to habit. In doing this we shall try to avoid the use of psychological terms, and modes of expression which are foreign to common experience.

There is no doubt a general willingness to admit that habit constitutes the very essence of a well organized and effectual life. As children we are taught to make as many as possible of the commonplace acts of life habitual, and as we grow older we become more and more subservient to the power of continually repeated acts, until finally we become, in great measure, automatic. This is regarded as an unmitigated good so long as the continually forming habits subserve the general welfare of the individual, and that edu-

cation is regarded as successful, which best brings this end to pass. As Prof. William James admirably puts it: "The great thing then, in all education, is to *make our nervous system our ally instead of our enemy.* It is to fund and capitalize our acquisitions, and live at ease upon the interest of the fund. *For this we must make automatic and habitual as early as possible, as many useful actions as we can,* and guard against the growing into ways that are likely to be disadvantageous to us as we should guard against the plague."* It requires no elaborate argument to see and realize the essential correctness of this point of view. We all of us recognize, in a more or less thoughtful way, that we are bundles of habit, and that so far as these habits are good they are serviceable to us, and so far as they are bad they are more or less harmful. In persons physically well the mixture of good and bad habits is regarded as inevitable, and certainly not noteworthy. When, however, through any cause the nervous system is, or has become unstable, it must happen that the tendency to the formation of a morbid habit is increased. It is, no doubt, just at this point that so many persons begin a life of partial nervous invalidism, brought about by the persistence of certain pernicious associations. Leaving aside all other questions then, our purpose in what follows is simply to draw attention to, and attempt to analyze some of the morbid conditions in which habit plays a predominant role.

It is not difficult to make a rough but practical classification into three divisions:

1. That in which without apparent cause a morbid association is aroused, and persists through repetition.

2. That in which an association is formed as the result of an imperfect interpretation of physiological processes.

3. That in which an association persists after its exciting cause has been removed.

* James: Principles of Psychology. Vol. I. p. 122.

In the first category may be placed a very large number of so-called neurasthenic conditions, whose source is often most difficult to determine. These are the patients who tell you they have been ailing for months or years. Their symptoms are often vague but annoyingly persistent; they know of no cause; they are not overworked. They are not neurasthenic in Beard's sense. A rest cure is just what they should not have. A persistent attempt to analyze the conditions brings us no further than to a settled conviction, that a fixed habit of experiencing certain morbid sensations has grown up, has fed upon itself, has finally so dominated the individual both mentally and physically that he is quite as likely to experience pain and discomfort in the various situations in which a normal person would experience only pleasure. These are difficult cases; their troubles are often temperamental, and an integral part of their character. They are, in great measure, the victims of perverted habit; their cure lies evidently not in drugs, but in a correction of their point of view, through a substitution of helpful for harmful trains of association. There is, no doubt, such a thing as a habit of health; and an equally definite habit of illness. Each day fixes the morbid habit, as in the healthy person each succeeding day brings a completer assurance of the health of the next. There are many of these border line cases; they merge on the one hand into what would generally be called the normal, and on the other into what every one would acknowledge as pathological.

Not long since I saw a young girl who was afflicted with an attack resembling hay fever, whenever she looked for any length of time at a cat. When I saw her she had been playing with a kitten for perhaps half an hour, and as a result was undergoing a marked conjunctivitis. Her eye was suffused; her nasal mucous membrane was discharging in a typical fashion, her throat was affected, and altogether

she presented a perfectly characteristic appearance of a hay fever victim. She is not a sufferer from hay fever ordinarily, and nothing but a cat produces this effect. On questioning she was absolutely unable to give a reason for the peculiarity. She was fond of cats, and could not recall the circumstances of her first attack. This affection is evidently a nuero-psychosis of the habit type, owing its origin to some unknown association, and its persistence to habit. A friend of mine who is a sufferer from hay fever, is annoyed in a similar way by contact with horses; his cure has been partially effected by a breaking up of the association, through wearing blue glasses. Prince narrates cases of a similar sort, in which the origin of the association is evident, and in which cure was affected by counter-suggestion.

These are merely examples of a very general principle which, undoubtedly, plays an important part in the persistence of many neuroses.

The second class is of much importance, not only theoretically, but also in view of the excellent results of treatment, when the condition is properly analyzed and interpreted. These are cases, who through ignorance of physiological laws form morbid habits, which result in distinct neuroses or psychoses. The commonest source of these disturbances is undoubtedly the sexual sphere. Both men and women are ignorant to an extraordinary degree of the normal function of the sexual organs. Everything is done by the charlatans in medicine to profit to their own gain by this ignorance, with the result that associations of a most pernicious sort are aroused, which grow in the usual ways to the discomfort and possible ruin of the individual. Cases of this sort are most familiar to us all, but their proper interpretation and successful treatment are far less common experiences.

The following is an example of this type of neuro-psy-

chosis. A student of perfectly clean venereal history brings this report: For over four years he has been worried regarding a purely physiological matter, which in his ignorance he has thought abnormal. In consequence he has formed the habit of waking with regularity at three in the morning, which has added to his anxiety and annoyance. He went to college and through his entire course grew gradually worse, inasmuch as his head also began to trouble him. He studied psychology, and learned something of cerebral localization, which he naturally interpreted to fit his own case. He associated his supposed sexual difficulty with his head sensation, and in the light of his acquired knowledge put the two together as cause and effect. His reasoning was, if the arms and legs have cortical centres, the sexual apparatus must also; hence all my symptoms. For years he had been taking drugs, naturally without effect. He graduated from college and was anxious to take up his life work, but felt absolutely incompetent. His confidence failed, he was nervous, and on the verge of a break-down. With a feeling of desperation and with small hope of relief, he again sought medical advice. His cure consisted in the assurance that he had formed a morbid habit through ignorance of certain physiological laws, which later study had fostered. No hypnotism was necessary; and the new point of view offered brought about the desired result. The following night he slept until about five instead of waking at three, and a letter several months later stated the permanence of the cure.

This case is a perfectly typical one, and extremely easy of analysis. The onset of the affection was due to the false interpretation of a physiological event; it was fostered by a constantly more elaborated scheme of association; it led finally to a complex neurosis or more properly phychosis, which was rapidly undermining the nervous constitution of the patient. Treatment consisted in a substi-

tution of a true for a false conception, and the habit of years' standing was immediately checked. Had the case been properly understood at the outset, those years of worry and unhappiness might easily have been avoided; had the condition persisted many more years the habit might as easily have become permanently fixed, to the lasting detriment of the nervous system.

There are many cases of a similar sort to this, some of them much less clear; but that this element of morbid association based on ignorance, is an almost constant factor in certain neuro-psychoses, no one who has observed will be disposed to deny. In many of the nervous disorders of women this factor is at work. It is sometimes encouraged and sometimes allayed, by efforts directed to the local treatment of the pelvic organs. The absolutely important point to bear in mind is, that however conspicuous the subjective symptoms may be, and at times the objective signs as well, we should all the more direct our attention to the possibility of habit as a fundamental factor in the production of the final morbid condition. Could we intelligently forewarn our patients of the ills of certain habits into which they unwittingly fall, a step of the utmost value in prophylactic medicine would be taken, and the whole group of wretched hypochondriacal states be at least limited in their possibility of harm. A realization of this fact, we are convinced, is much needed by practitioners of medicine in every field. We have taken the sexual system as a characteristic example, but we do not wish therefore to be understood that the significance of this type of neurosis is confined to this sphere. On the contrary it is very general in its manifestation, and is to be considered under manifold conditions. Further examples are the association of colds with damp feet and draughts in certain individuals, leading so often to a helpless slavery, or digestive disturbances following the eating of ordinarily harmless articles of food.

The third class which we have marked out is that in which a disturbed nervous state persists long after its exciting cause has been removed. In general, that large and constantly more important group of psychoses or neuroses following trauma is to be included in this class. In this connection we shall confine ourselves only to those results of trauma which are not connected with legal proceedings. We need offer no argument to prove that various nervous disorders do follow trauma; that is generally accepted. Our purpose is merely to trace one of the ways in which such disorders are perpetuated, following out the principle already outlined.

An illustrative case will best demonstrate our point. A man previously healthy falls on his shoulder, thereby sustaining an injury to the joint and its neighboring structures. His arm is temporarily disabled. His chief complaint is of pain in and about the joint, which is so severe that the arm is held practically immovable. He gives up doing any work which requires the use of the shoulder muscles, on the ground that the pain is too severe to permit it. The arm hangs helpless at the side. At the end of three months the patient presents himself at the hospital. Examination then shows, in other respects, a healthy man who holds his arm flaccidly at his side as if through an injury to the brachial plexus. There is, however, no marked muscular atrophy. On attempts to move the arm each effort is vigorously resisted by the patient with incessant complaint of pain. It is quite impossible for this reason, and on account of muscular spasm, to raise the arm to the horizontal, or in fact to move it freely in any direction. Voluntary movements of any magnitude on the part of the patient are not possible. From the history and physical appearances there was in this case no great hesitation in making a diagnosis of periarthritis, which subsequent events proved to be wrong. By way of instruction to the patient certain passive movements

of the affected arm were made, which no less to his than to my surprise were brought about with more freedom and less pain than either had expected. In a few moments the patient could move the previously helpless arm almost as well as the sound one. His astonishment was extreme. He left the hospital temporarily cured and returned a few days later with the same disability, in spite of his efforts to help himself. He was again easily relieved, and has not since been seen.

Here again is a typical and exceedingly important type of disturbance. Its genesis is perfectly clear. A man falls and receives a definite injury, from which follows an actual disability, associated with pain. As the mechanical effects of the injury pass off, the pain persists in spite of the fact that its cause has been removed, and to the patient this idea of pain is as real as was the original pain. He has, in other words, formed a definite habit, which persists and tends to increase; the arm therefore remains helpless until the association is violently broken in upon; and even then tends to recur. It is a mere begging of the question to call such an affection hysterical, a term too much and too loosely used. Whether hysterical or not, the process remains to be explained. Its explanation lies in the line we have suggested, at least in part, in very many cases. The failure to recognize such conditions is a just reproach to the physician. By such failure many psycho-neuroses are engendered and propagated, until finally the association becomes so firmly engraved in a nervous system, that relief is difficult if not impossible.

A case, for example, comes to my mind in which a headache has persisted for fifteen or more years as the result of a trifling injury to the head, so firmly has the association of pain with a fancied fracture of the skull become fixed in the patient's mental life. The duty and the opportunity of the physician are clear in such cases.

Without further multiplying examples, we have seen, if the foregoing be accepted, that habit is an enormously important element in the perpetuation of certain morbid states. It all seems clear enough if we may only realize that a pathological habit is, in one sense, as physiological as a normal habit. To live always with a sense of well-being and health is accepted as natural; to be continually dragged down by pain and discomfort is looked upon as abnormal, but the two are, after all, simply habitual reactions of the nervous system to certain conditions, and the one is quite as natural as the other. The nervous system does its work well in either case; the fault lies with the unfortunate tendencies which determine the character of the neural associations. The nervous system is at first plastic, and easily moulded into right channels, but none the less easily, when certain strains are brought to bear upon it, into wrong ones. Some of those strains we have considered, and their power for harm when directed against an unstable nervous system. It is often possible for the physician to bring just that quality to his patient, which will permit him "to make of his nervous system his ally instead of his enemy."

ARTICLE XLIII.

ANTITOXIN IN THE TREATMENT OF DIPHTHERIA.

By JOHN H. McCOLLOM, M.D.
OF BOSTON.

READ JUNE 7, 1898.

ANTITOXIN IN THE TREATMENT OF DIPHTHERIA.

THE use of antitoxin in the treatment of diphtheria has passed the experimental stage and its advantages in the treatment of this disease are now generally recognized. There are, however, some members of the profession who from insufficient experience or from a series of unfortunate cases are inclined to throw discredit upon the remedial power of the healing serum. There are others, who claim that the administration of antitoxin has a deleterious effect on the heart, and that it is an important factor in causing renal disease. The object of this paper is to show that the death-rate from diphtheria has been materially reduced since the introduction of antitoxin, and also to prove that this agent has no injurious action on the heart, and that it cannot be considered as being the cause of the renal complications occurring in the course of diphtheria.

Diphtheria has until the past two years been a very important factor in increasing the death-rate of Boston. The percentage of mortality from diphtheria in this city from 1880 to 1894 was 30.75, while that from 1895 to 1897 was 12.61. The ratio of mortality from diphtheria per 10,000 of the living has been quite large, but during the past three years it has gradually diminished. An examination of mortuary statistics for ten years from 1888 to 1897 shows that in 1888 the ratio was 13.88 per 10,000; that in 1889 it was 15.65; that in 1890 it was 10.30; that in 1891 it was

6.23; that the rate in 1892 was 10.29; that for 1893 it was 11.45; that in 1894 it was 18.03; that in 1895 it was 11.73. It was during this year that antitoxin began to be generally used, and we see a marked reduction in the mortality rate as compared with that of the previous year. The rate in 1896 was 9.80, and that for 1897 was 7.7. If we compare the rate for 1894, which was 18.03, with the rate for 1897, which was only 7.7, it will be seen that there has been a diminution of more than one half. If we go back to the semi-decade from 1861 to 1865 the ratio is found to be 11.10, while in the semi-decades from 1866 to 1870 and from 1871 to 1875 the ratios are 6.54 and 7.20. This low death-rate can be explained by the fact that diphtheria was not then so carefully studied as it is at the present time, and that the diagnosis was not based upon a bacteriological examination, and therefore many cases which were diphtheria were not recognized as such. For instance, in Boston in 1872 with a population of 265,764 there were only 94 deaths from this disease. It is not reasonable to suppose from what is known of the prevalence of diphtheria at the present time, that during 1872 there could have been only 94 deaths from so fatal a disease as diphtheria. It has been claimed by the opponents of antitoxin that the mortality statistics of this disease are fallacious because by a bacteriological examination many mild cases are recognized as diphtheria which formerly would have been classified as tonsillitis and other inflammatory processes in the throat. While this may be true to a certain extent, yet this so-called source of error cannot be considered an important factor in invalidating the accuracy of the statement that the ratio of mortality from diphtheria has materially diminished since the introduction of antitoxin.

In Berlin, for the four years from 1890 to 1893, the percentage of mortality from diphtheria was 35.34; that for the four years from 1894 to 1897, inclusive, when antitoxin

was used, the death-rate was 18.08. As these statistics embrace a period of eight years, and comprise in the first four years 16,088 cases of diphtheria, and in the second four years 19,394 cases, the argument that not a sufficient number of cases has been observed can have no weight; neither can the argument that the type of the disease has become milder have any significance, for the time is long enough for the type to change from mild to severe, and from severe to mild.

In an analysis of the ratio of mortality in 266 German cities of about 15,000 inhabitants, it was found that the ratio of mortality, per 100,000, of the living before antitoxin was used, varied from 130 to 84 from 1886 to 1893, while the ratio from 1894 to 1897 varied from 101 to 35. It is a significant fact that during 1894, when although antitoxin was used to a certain extent it was not in general use, the ratio was 101; that when antitoxin was used more extensively, in 1895, the rate was 53; that in 1896 it was 43; that in 1897, when antitoxin was very generally used, the rate fell to 35. This diminution is so marked, and has been so gradual, that it cannot be explained by any change in the type of the disease. In Paris a similar condition has been observed; for instance, from 1890 to 1893, the deaths from diphtheria varied from 1,639 in 1890 to 1,262 in 1893. In 1894, when antitoxin commenced to be used, the number of deaths fell to 993. In 1895 there is the astonishing diminution to 411. In 1896 the deaths were 445, and in 1897 there were only 274. In Boston the diminution was nearly as great. The most important argument, however, in favor of antitoxin is the diminution in the percentage of mortality in hospital cases. It has also been claimed that these statistics were unreliable because based on mild attacks of the disease; but this statement cannot be considered correct because mild cases of disease are not sent to hospitals, as a rule.

The hospital death-rate from diphtheria before the introduction of antitoxin not only in this country but also in Europe, was about 46 per cent. In the South Department of the Boston City Hospital since it was opened, September 1, 1895, to the 1st of May, 1898, there have been 4,196 cases of diphtheria treated, with a percentage of mortality of 13.7. Lest it might be said that diphtheria might have assumed a milder type during these two years and eight months, it may be of interest to note that in the first five months the percentage was 13; that in the year ending February 1, 1897, it was 15.3; in the year ending February 1, 1898, it was 13.5, and in the three months ending May 1, 1898, 11.1. The diminution in the mortality rate in the last three months can be explained by the fact that cases are now sent to the hospital earlier than formerly, and therefore they receive the full benefit of the treatment. Experience has demonstrated the importance of giving antitoxin at the earliest possible time in the course of the disease. If the moribund cases or the cases that died within twenty-four hours of admission are eliminated the death-rate of cases amenable to treatment would be about 9 per cent. It must be borne in mind that these were diphtheria both from a bacteriological and from a clinical point of view.

In the hospitals of Berlin the death-rate from 1885 to 1894 varied from 41 per cent. in 1885, to 28 per cent. in 1894. In 1895, when antitoxin was generally used, the percentage of mortality was 16. In 1896 it was 13, and in 1897 it was 13. In no single instance has there failed to be a diminution in the death-rate from diphtheria in hospitals where antitoxin has been used. In some instances the percentage has diminished two-thirds. In cases in private practice the diminution in the mortality rate has been equally marked. Some observers have given as low a death-rate as 8 per cent. Of course it will be said, by the oppo-

nents of antitoxin, that many of these cases were mild, and that they would not have been recognized as diphtheria if it had not been for a bacteriological examination. As the statistics on which this death-rate was based were compiled by men of large experience in the treatment of this disease, we must accept their statements as conclusive proof of the antidotal power of the anti-diphtheritic serum.

In the laryngeal cases antitoxin has been as effective as in the pharyngeal cases, a large percentage of the patients having been relieved without the necessity of an operation. In the Report of the American Pediatric Society on the Antitoxin Treatment of Laryngeal Diphtheria in private practice, comprising 1,704 cases, the statement is made that the death-rate was 21.12 per cent. Of these cases, 1,036 did not require operation, and the percentage of mortality was 17.18. In the operative cases the results have been equally gratifying. In 5,546 intubation cases, collected by McNorton and Maddren in 1892, the mortality was 69.5 per cent. In 370 intubations reported by O'Dwyer, from his personal experience, the percentage of mortality was 72.44, before antitoxin was used. In 59 intubation cases, reported by O'Dwyer, after the advent of antitoxin, the mortality was 23.7 per cent. At the Boston City Hospital, for the year ending January 31, 1895, the percentage of mortality in intubation cases was 83. Very few of these cases had antitoxin. In the South Department from September 1, 1895, to May 1, 1898, the percentage of mortality in 457 cases has been 55 per cent. For the three months ending with the 1st of May, 1898, there have been 28 intubations with 8 deaths, with a percentage of mortality of about 28. It is a very significant fact that the condition of these patients admitted in the last three months showed that they had only been ill a short time, which only emphasizes the great importance of the early administration of antitoxin and prompt operative inter-

ference. It must be borne in mind that hospital cases, as a rule, are not admitted until their condition is such that the golden opportunity for administering antitoxin has passed, and this explains the fact that the death-rate in hospital cases is a little higher than that occurring in private practice. For the relief of laryngeal stenosis, for laryngeal stenosis in the majority of instances is caused by diphtheritic membrane, intubation is the operation to be preferred. A careful analysis of a large number of cases of tracheotomy as compared with an equal number of intubations, proves conclusively that the death-rate in the former operation is much larger than in the latter.

In the operative cases at the South Department broncho-pneumonia was responsible for 55 per cent. of the deaths. As broncho-pneumonia cannot be considered a part of the diphtheritic process, but is essentially a complication, the occurrence of this lesion cannot be used as an argument against intubation or against the use of antitoxin. There is no doubt of the importance of the early administration of antitoxin, not only in the laryngeal cases, but also in the other forms of diphtheria.

Although intubation is the operation of election in children, tracheotomy in adults is to be preferred. The following tracheotomy case is worthy of mention, as an illustration of the beneficial effects of antitoxin. The patient was a man twenty-five years of age. He had been ill three days. There was extreme prostration, great glandular enlargement and excessive œdema of the neck. The tonsils were very much enlarged, meeting in the median line. There were large patches of membrane on each tonsil, on the uvula and on the hard palate. There was intense hyperæmia of the mouth. Patches of necrotic membrane could be seen; the patient was cyanotic. A strong septic odor was noticed. Heart sounds were feeble. Temperature 99°. In short the patient was almost moribund; in fact when he was put

in bed he stopped breathing. The trachea was immediately opened and artificial respiration was commenced. At the end of a few minutes he gasped, began to breathe naturally and became conscious. On the fifth day the membrane commenced to be detached. He had five large doses of antitoxin at intervals of twenty hours, and was very freely stimulated. On the fifth day the tube was removed. On an examination of the throat the uvula which had been covered by the swelling of the tonsils could be seen. At no time did the temperature rise above 104°. The patient had a moderately severe attack of pneumonia. Œsophageal feeding was given owing to the inability of this patient to swallow, partly on account of paralysis, and partly on account of the swelling of the fauces. At intervals the feeding caused vomiting, and nutrient enemata were tried. He made a slow recovery owing to post-diphtheritic paralysis, which was general. There is no doubt that this patient owes his life to tracheotomy and also to antitoxin; the one would have been powerless without the other. Careful feeding and heroic stimulation were also very important factors in contributing to his recovery.

Diphtheria of the eye has been justly considered one of the severest affections of this organ, and the treatment was formerly eminently unsatisfactory. At the South Department there have been fifteen cases of undoubted diphtheria of the eye, in which in nearly every instance the sight would have been lost, if it had not been for the heroic administration of antitoxin. Of these fifteen cases, in only one instance was there destruction of this organ, and in this case if the eye had been in a normal condition at the commencement of the attack, there is no doubt that it would have been saved. When a diphtheritic membrane appears in the eye the effect of antitoxin on the membrane can be more carefully studied than when it appears in the pharynx. In some of these eye cases 2,000 units were given as the

initial dose, and this was repeated in six or eight hours, if there was not a marked improvement. In some instances it was necessary to give three or four doses. Without going into the minute history of each case it is sufficient to say that these were cases of genuine diphtheria, both from a bacteriological and from a clinical point of view. In addition to antitoxin an ointment of red iodide of mercury, and in some instances the yellow iodide in the proportion of one grain to the ounce of vaseline, was used. The pupils were dilated by atropine, and in some instances cocain was used. In all these cases the source of infection could be directly traced to a nasal discharge loaded with the bacilli of diphtheria.

It has been stated, by the opponents of antitoxin, that the serum does not have any effect in restricting the formation of the membrane. In reply to this it must be said, that a person who makes such a statement cannot have carefully observed his cases, for any one with experience in this remedy must have noticed the peculiar effect that the healing serum has on the membrane. If a sufficiently large dose is given, at the end of six or eight hours in favorable cases, the membrane commences to roll up at the edges and is undermined. The mucous membrane of the throat near the site of the diphtheritic membrane assumes a more normal appearance. The pain and soreness diminish. If there has been glandular enlargement this also commences to diminish. If however this favorable change does not take place at the end of from six to eight hours, a second dose must be given, to be followed by a third, a fourth, or even a fifth, until the characteristic effect of the serum is produced. Except in the case of very young infants, the initial dose should always be 2,000 units, and even in severe cases 4,000 units may be given. The amount of fluid and not the inherent principle of antitoxin is the only possible source of danger in giving very large doses of

this agent, and therefore the more concentrated the preparation the better. There is much greater danger of giving too small than too large a dose of antitoxin. The difficulty of knowing just what amount of antitoxin should be administered is due to the fact that we do not know how much of the toxin of the disease is to be antagonized. In the case of Guinea pigs that are used for testing the serum a certain definite amount of toxin is injected and this is antagonized by a certain amount of the healing serum. In the case of human beings ill of diphtheria, however, it is impossible to know the degree of toxicosis and therefore it is far better to err by giving large doses than to make the mistake of giving too small doses. There is not the slightest evidence, in a careful clinical study of 4,196 cases of diphtheria, that antitoxin caused any serious trouble. It is true that urticaria and arthralgia have occurred in a comparatively small proportion of these cases, but these symptoms are not of sufficient gravity to deter any physician, who has the well-being of his patients at heart, from the administration of antitoxin. The whole matter may be summed up in these few words. Diphtheria; antitoxin; possible urticaria and arthralgia; recovery. Diphtheria; no antitoxin; probable death. Which do you prefer? A short account of the two following cases may be of interest as showing the importance of giving large doses of antitoxin in severe cases of diphtheria. It may be remarked in passing that the hospital records contain a great number of similar cases, but to give a detailed account of each severe case cured by antitoxin, would weary your patience and increase the size of this paper beyond all reason.

Case 1. A girl, seven and one-half years of age. She had been ill four days. Her condition at entrance was as follows. Marked prostration, strong septic odor and great glandular enlargement. Profuse nasal discharge. Tonsils very much enlarged and covered with thick diphtheritic mem-

brane. Uvula and hard palate covered with membrane. Temperature 100°. Pulse 120. General condition indicating profound poisoning by the toxin of diphtheria. At 5 P. M. she had 2,000 units of antitoxin. This dose was repeated in four hours. Two doses of 2,000 units each were given the next day. On the third day she had one dose of 2,000 units. On the fourth day she had two doses of 2,000 units each. After the third dose the membrane commenced to roll up at the edges, but, as the improvement in the condition of the membrane was not as rapid as could be desired, the remaining four doses were given. On the fifth day after entrance the throat was practically clear. In addition to antitoxin the patient was very freely stimulated, both with alcoholic and cardiac stimulants. Nourishment was an important factor in the treatment. There is no doubt that antitoxin saved the life of this patient, neither is there any doubt that if the remedy had been administered the first day of her illness the membrane would not have extended, and she would not have been so critically ill. This patient had 14,000 units of antitoxin, or in bulk 140 cc. She made an uninterrupted recovery and was discharged well.

Case 2. A girl, seven years of age, had been ill three days. On entrance she had a profuse epistaxis; there was a very strong septic odor; marked glandular enlargement and a very extensive deposit of membrane covering the tonsils, uvula, and nearly two-thirds of the roof of the mouth. She was in a state of collapse and apparently had but a few hours to live. This is the severest case of diphtheria that I have ever seen recover. On the day of entrance she had two doses of antitoxin of 2,000 units each. On the second day she had three doses of 2,000 units each. On the third, fourth, fifth, sixth and seventh days after entrance she had 2,000 units each day. In all, this patient took 20,000 units of antitoxin, or in bulk 200 cc. There was not the slight-

est irritation about the point of inoculation, neither were there any untoward symptoms attributable to antitoxin. The patient made a good recovery. It is not possible to vividly portray the critical condition of this patient when admitted to the hospital. Any sane man who treated diphtheria before the days of antitoxin, if he had seen this case, could have no doubt that the patient owes her life to the administration of this agent. These two cases are of particular interest because they were cases of uncomplicated diphtheria, and therefore derived full benefit from the serum. In cases of mixed infection although antitoxin has its antidotal effect on the diphtheritic process, it has no effect on a streptococcus poisoning, or in attacks of broncho-pneumonia. The majority of cases of diphtheria treated by antitoxin, that die, succumb, not from diphtheria, but either from a streptococcus infection or from broncho-pneumonia. In the 4,196 cases of diphtheria that have been under my personal observation, in only three cases has the membrane extended, after the administration of antitoxin, and then only to a limited degree. If the cases that died from broncho-pneumonia and degeneration of the pneumogastric nerve are eliminated, the percentage of deaths from uncomplicated diphtheria treated by antitoxin would be surprisingly low, so low that it would hardly be credited.

A word might be said regarding the temperature in diphtheria. A high temperature in diphtheria indicates some complication. In an analysis of 800 cases of diphtheria, studied with this special point in view, it was observed that of 121 fatal cases, 16 had a temperature of above 103°; that the remaining 105 had a temperature ranging from normal to 103°. The high temperature in each instance was proved, either by the clinical symptoms or by the autopsy, to have been due to some complication. Of the 679 non-fatal cases, which form a part of the 800, only 55 had a temperature of 103° and above.

The importance of the early administration of antitoxin in large doses is not sufficiently appreciated. In order to get the full benefit of this agent, it must be given at the earliest possible moment. A delay of twenty-four hours frequently imperils the life of the patient, or at least prolongs the attack. Laboratory experiments have demonstrated conclusively, that if the mucous membrane of animals was painted with pure cultures of diphtheria bacilli, and antitoxin was administered at the same time, no membrane was formed. If on the other hand twenty-four hours elapsed after the animals were inoculated, before antitoxin was given, membrane was formed; if there was an interval of forty-eight hours the animals generally died. It may be said that these are laboratory experiments and therefore the conditions are not the same as in clinical diphtheria. In reply it can be said that since the South Department was opened there have been sixty cases of diphtheria among the attachés of the hospital, and there has not been a single death. In each case antitoxin was administered upon the appearance of the very first symptoms of the disease. To antitoxin, and to antitoxin alone, must be given the credit of this gratifying result. There was a very different experience in the City Hospital proper, in the diphtheria wards, before the days of antitoxin.

It has been stated, that antitoxin has an injurious effect on the heart; that cases of sudden death are more common after its administration. A careful study of diphtheria before antitoxin was used shows conclusively that heart complications were exceedingly frequent, more so than at the present time. Mollard and Regaud proved by their experiments on dogs and rabbits injected with fatal doses of diphtheria toxin, that the process in the heart is similar both in symptoms and in pathological appearances to that found in human diphtheria. Different observers as far back as 1878 found marked changes in the nervous structure of the heart and in the

muscle itself, due to the absorption of the diphtheritic toxin. This proves that heart complications were recognized long before antitoxin was used. It is a significant fact, that the majority of the patients who died from heart complications, at the South Department, had been ill three or four days before antitoxin was administered, and therefore the bacilli of diphtheria had sufficient time to generate toxin enough to cause degeneration of the nervous structure of the heart. This would seem to be a sufficient answer to the statement, that antitoxin causes heart complications. There is not the slightest scintilla of evidence, either from the clinical study of the cases or from the result of autopsies, that antitoxin has any injurious effect upon either the heart muscle or its nervous structures.

It has been claimed that antitoxin causes albuminuria. This symptom however, occuring in the course of diphtheria, was recognized long before antitoxin was used. An analysis of the urine in 173 cases, treated at the South Department, was made before and after the administration of antitoxin. Of these 173 cases it was found that in 99 instances albumin was absent both before and after this agent was used, which was without doubt due to the fact, that the healing serum was given before the diphtheritic membrane had increased sufficiently to generate toxin enough to cause albuminuria. In 33 cases the albumin was about the same; in 25 it was diminished; in 16 it was slightly increased, but not to a sufficient extent to cause any special anxiety. The conclusion, therefore, that albuminuria, when it occurs in the course of diphtheria, is caused by the toxin of the disease and not by the healing serum, is justifiable. In investigating the results of any special course of treatment in a given disease, it is well to know something of the natural history of the disease, and the importance of this the opponents of antitoxin have not fully appreciated.

Cutaneous manifestations and arthralgia are unfortunate complications that follow the use of antitoxin, but these are never of sufficient gravity to constitute an argument against the use of antitoxin. That abscesses sometimes occur after the injection of antitoxin, is a direct reflection on the man who gives the injection. If the parts are thoroughly sterilized; if the syringe is boiled a sufficiently long time; if the operator's hands are sterile; if the serum has not commenced to decompose, abscesses will not form. After a bottle of serum is opened, if the contents are not all used at one injection, the remainder should be thrown away; for if the serum is exposed to the air, even for a limited time, it is very likely to decompose, and therefore the liability to the formation of abscesses is very much increased. At the South Department, in the last few months, there have been 500 doses of antitoxin given without a single abscess, which proves that the sterilization has been effective.

Various situations have been selected for the site of the injection, but experience has taught me that the upper part of the thorax, near the posterior axillary line, is the best place. If unfortunately through some fault in technique an abscess does form, the pus does not burrow to such an extent as it would in the thigh or in the back. It is essential that the syringe should be made of glass with asbestos packing, so that it can be thoroughly sterilized by boiling.

From an examination of mortuary statistics, both in this country and in Europe; from a clinical study of 4,200 cases of diphtheria, it seems to me that the following conclusions are absolutely correct:

First. That the death-rate of diphtheria has been reduced to a remarkable degree by the use of antitoxin.

Second. That in order to derive full benefit from this agent, it is important that it should be given in large doses, early in the course of the disease.

Third. That antitoxin should be frequently repeated, until the characteristic effect is produced on the diphtheritic membrane.

Fourth. That antitoxin does not cause albuminuria, and that it has no effect in producing heart complications in this disease.

Fifth. That the physician, who does not use antitoxin in the treatment of diphtheria, fails to do his whole duty to his patient.

ARTICLE XLIV.

THE TOXIN OF DIPHTHERIA AND ITS ANTITOXIN.

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THE TOXIN OF DIPHTHERIA AND ITS ANTITOXIN.

EVER since Roux and Yersin demonstrated the fact that diphtheria bacilli act in the main through a soluble poison or toxin which they produce during multiplication, this toxin, as well as those of other pathogenic bacteria, has been the object of considerable attention on the part of experimental medicine. The discovery of the antitoxic properties of the blood of immunized animals by Behring and Kitasato in 1890 was a signal for the renewed study of the toxin for which a true antidote had now been found.

In accordance with their facilities and command of methods, experimenters have been exploiting the nature and action of toxins in different directions, some applying the methods of physiology and physiological chemistry, others those of pathological anatomy, still others those of experimental biology. Though we must acknowledge that we are only within the threshold of this work, it is difficult not to see what great progress has been made. Ten years ago a vague knowledge of the existence of bacterial poisons is all that we possessed. Of the existence of antitoxins there was not a hint. Since then a new horizon has come into view fully as great in its sweep as that which presented itself to the great discoverers in the domain of micro-örganisms. For while the latter revealed to us the swarm of enemies that beset us, the former unfolds before us the forces that the animal body holds in readiness for them.

An exhaustive review of the various additions to our stock of information upon the toxin of diphtheria would far

exceed the time limit of this paper. I shall, therefore, restrict my remarks to a brief resumé of those facts and theories which appeal to the physician who is confronted by questions not in the laboratory but at the bedside.

The immediate objects of most of the investigations made in recent years may, for convenience, be grouped under three heads:

(1) A clearer insight into the nature of toxins and of their action upon the various tissues of the body and cells composing them, in order that diphtheria as well as other toxic diseases may be better understood.

(2) More information concerning the essential nature and specific action of antitoxin. And

(3) The improvement of the antitoxins and the cheapening of their production.

Before entering upon a discussion of these subjects it may be well to briefly review the established facts and some unestablished theories concerning the action of the diphtheria bacillus itself. While attention has been most exclusively focused upon the toxin it should be borne in mind that the bacillus is, after all, the exclusive manufacturer of this product, and that the character of the bacillus and its adaptation to the conditions found on mucous membranes determines from the beginning the gravity of the infection.

In the presence of suitable food substances, among which, in artificial cultures, the albumoses or so-called peptones seem to stand at the head, the diphtheria bacillus during its multiplication produces a poison or toxin which diffuses promptly from the cell body in which it presumably arises into the surrounding fluid. After removal of the bacilli from the culture fluid, this is capable of producing experimentally the various lesions including paralysis, ascribed to the diphtheria bacillus when it attacks the human subject. The bacillus, conveyed from one person to another, seems to vegetate al-

most exclusively upon exposed surfaces, primarily mucous membranes, secondarily wounded areas of the integument.

The hyperæmia and exudation which follow the earliest absorption of toxin, supply the bacillus with a suitable nidus in which to continue its multiplication and produce more toxin. In this way the diseased area spreads, the poison is manufactured and absorbed more abundantly, and constitutional symptoms indicated by fever and prostration appear. The microscope informs us that during the earliest local manifestations, the usual, scant, miscellaneous bacterial flora of the mucosa is quite suddenly replaced by a rich vegetation of the easily distinguishable diphtheria bacillus. Frequently no other bacteria are found in the culture tube. This vegetation continues for a few days, then gradually gives way to another flora of cocci and bacilli, and finally the normal condition is reëstablished. The disease process is probably checked in all cases by the appearance of antitoxin in the blood produced by certain tissues or cell groups under the stimulus of the diphtheria toxin. Now-a-days the antitoxin in the serum of the immunized horse is introduced to hasten and increase the resistance of the body.

Diphtheria bacilli vary slightly in their capacity to produce toxin in culture-fluids. A comparative study of over forty cultures of diphtheria bacilli from different towns of this State,* carried on under uniform conditions, showed that some bacilli produced from two to three times as much toxin in a given time as others. This quantitative production seems to remain indefinitely the same for each bacillus, so that the inference that there is some difference in the bacilli studied, cannot well be rejected. Just what bearing this difference would have upon the human subject we cannot easily determine, owing to the many

* Theobald Smith and E. L. Walker; Report of the State Board of Health of Massachusetts, 1897, p. 649.

variable conditions and the now prevalent antitoxin treatment.

Given the power to produce toxin, the important question arises as to the nature of the impulses which start the multiplication of diphtheria bacilli on mucous surfaces. The commonly accepted view is that the bacilli need only to reach the throat of a susceptible individual to multiply. But insusceptibility does not necessarily prevent multiplication, for this may go on for several months after the recovery of patients. If diphtheria bacilli could multiply on mucous membranes as soon as they reach them there would be many more healthy persons than are now found harboring diphtheria bacilli. I am inclined to believe that slight injury to the membrane, such as erosions, traumatism, hyperæmia followed by slight exudation due to exposure, and possibly certain undetermined chronic affections, favor and perhaps determine multiplication after infection in primarily susceptible individuals. It is highly probable that the special food needed by the diphtheria bacillus to produce toxins comes from the blood and becomes available through lesions of the mucous membrane. The injury may be of the slightest character and still afford a foothold for the bacilli, after which their multiplication with toxin production will lead to the spreading of the disease process.

This theory would help to account for the great increase of diphtheria in the colder season of the year, which increase is in part accounted for by the great overcrowding of living rooms in winter and the better opportunities for infection thereby offered. It would also account for the occasional discovery of bacilli in the throat a few days before the outbreak of the disease and harmonize with the experimentally demonstrated fact that toxins are harmless upon normal mucous membranes.*

* After the completion of this manuscript the work of Morax and Elmassian (Annal. de l'Institut Pasteur 1898, p. 210) on the action of the diphtheria

While infection will always play the dominant rôle in communicable diseases, the determining influence of accessory causes must not be lost sight of. These, I think, will form the great themes of study in the near future.

The persistence of diphtheria bacilli in the throat after the local and general disturbances have disappeared has been at first regarded as of little significance because the belief had been disseminated that such bacilli had lost the power to produce toxin. This, unfortunately, is not true. In the article quoted above, special attention was paid to this important subject. Even after a prolonged sojourn in the throat the toxin production of the bacilli was up to the average. Their harmlessness to the recovered patient may be referred to the presence of antitoxin in the blood, possibly also to the fact that the substances upon which the bacilli live in the normal throat may not yield that abundance of toxin furnished by the pathological exudates. Whatever the explanation may be, the potential danger of such cases as foci of the disease must be accepted in the light of recent researches.

Another subject of great importance, clinically, is the not infrequent occurrence of so-called septic forms of diphtheria, generally referred to the presence of adventitious pathogenic forms, such as streptococci and possibly of other little known bacteria. The source of the pathogenic forms is most consistently referred to some preëxisting lesion in the mouth or throat, such as catarrh, carious teeth, and lesions of the mucous membrane. Evidently the combina-

toxin on mucous membranes, came into my hands. These authors experimented upon the conjunctiva of rabbits. By instilling with the utmost caution a few drops of very strong toxin every 3 minutes for a period of 8 to 10 hours, characteristic diphtheritic changes of the conjunctival mucosa were produced. Less prolonged contact failed to cause any reaction. The nasal mucosa remained unaffected. This experiment simply shows that all tissues must give way eventually. If we assume that the mucosa in absorbing the toxin has the power of transforming it, this power will be broken down in time. Again, the instilling of a ready-made toxin of great strength does not mean that the diphtheria bacillus is in a position to manufacture it on the intact mucosa.

tions of bacteria with diphtheria bacilli may be many, and the conditions favoring them very variable. No satisfactory light has been shed upon these mixed infections. We know from almost daily experience that certain groups of bacteria growing in nutritive fluids with diphtheria bacilli favor the production of toxin materially, while other groups decidedly interfere with it. The toxin produced under such conditions is still diphtheria toxin, for it is neutralized by antitoxin in the usual way. The frequently unsatisfactory course of such cases may be due to the actual invasion of the body by the accessory bacteria, or to the continued expansion of the disease process locally under their influence whereby the diphtheria bacillus is favored in spite of antitoxic influences. Diphtheria antitoxin acts specifically upon diphtheria toxin and on this only. Hence the interposition of other pathogenic bacteria is likely to disturb the expected therapeutic action of the serum. The importance of early treatment becomes manifest when we consider that the septic bacteria may be at first favored by the diphtheria bacillus, and then when once established return the favor by supporting it.

It is also possible that non-specific inflammation of the throat due to pyogenic bacteria may precede the infection with diphtheria bacilli. The history of exposure and the clinical course of the disease in the early stage, combined with bacteriological examination of the throat, should bring to light such cases if they actually occur.

The extensive bacteriological studies of mixed infections made by Roux and Yersin, Martin, Barbier, Bernheim and others, have not been able to establish certain somewhat fanciful hypotheses of the action of streptococci upon diphtheria bacilli.* It would seem that the same processes

* In artificial mixed cultures the streptococci are probably unfavorable, the staphylococci favorable to the production of diphtheria toxin. This I infer from their general biological characters, as I have not made any direct experiments with them. Clinically, the streptococci, however, are regarded as the most dangerous secondary invaders.

are at work as in ordinary wound infections. The diphtheria bacillus starts the lesion; the streptococci actually present take advantage of the wound to penetrate into the body. The greater the lesion and the more abundant the injured tissue and the exudation, the more favorable the conditions for the secondary invaders. The more virulent these are, as v. Dungern* states, the more severe the disease that follows their entry and multiplication. This element of virulence among the secondary invaders is probably the most potent; next would come the extent of the throat lesion upon which they are grafted. In this connection it may be interesting to note that Bonhoff† was able to produce in guinea-pigs a glomerulo-nephritis when cultures of diphtheria bacilli were injected, which had been prepared either by inoculating streptococcus cultures with diphtheria bacilli, and thus producing mixed cultures, or else by inoculating sterile filtrates of streptococcus cultures with diphtheria bacilli.

Experiment is unable to exploit many problems relating to bacteria pathogenic to man, and we must content ourselves in many respects with hypotheses adapted as closely as possible to truths already established. This difficulty obtains when we endeavor to seek information concerning the relative virulence of bacteria as distinguished from their toxicity. By virulence, I mean the power of bacilli to implant themselves upon living tissues, and resist bactericidal forces. It is evident that a virulent bacillus need not necessarily be a potent toxin producer. Virulent bacilli would include such as are readily infectious and which are likely to produce epidemics. Such epidemics need not be associated with a high mortality. The important factor is the spreading tendency of the disease. While we are able to compare the toxin production of different bacilli, the

* Beiträge zur allg. Pathol. XXI. p. 104.
† Hygien. Rundschau.

relative virulence is not determinable because there is no species of animals which contract diphtheria spontaneously and upon which experiments might be made.

Leaving now the bacillus itself, we will turn to the toxin. This is demonstrable in culture fluids from which all bacilli have been removed by its pathogenic properties. Its action upon guinea-pigs is characteristic and the same qualitatively whatever culture may have produced the toxin. The course of the experimental disease is determined by the quantity of toxin administered. Thus the dose which is fatal to a guinea-pig in two and one-half days, when doubled is, as a rule, fatal in one and one-half days. With the larger number of bacilli we have studied, about 0.08 cc. of the filtered culture fluid suffices to prove fatal to a guinea-pig of 300 grams in three or four days. A few bacilli have been found which produce a toxin quantitatively ten times as strong as the average. The lesions vary in intensity according to the dose of toxin injected. When death ensues very rapidly within twenty-four hours, very slight hemorrhagic changes are found at the place of injection. When the disease lasts thirty-six hours, there is more or less œdema associated with hemorrhage at the place of injection, the lungs are œdematous, and are compressed by a clear colorless effusion in the pleural sacs. The adrenal bodies are deeply reddened. When the disease lasts more than two days, the pulmonary œdema and pleural effusion are absent, and the local œdema is replaced by induration of the tissues, sloughing and ulceration. The whole process seems to be started by an injury to the vascular walls whereby œdema, thrombosis and hemorrhage, and the inevitable necrosis, follow one another in proper sequence. The pulmonary œdema is also apparently the result of an injury of the vascular walls by the toxin. The lesions are thus akin to those which appear on the mucous membrane in the human subject.

Further than this the guinea-pig may show lesions of the nervous system manifested by disturbances of locomotion of greater or lesser severity and extent, involving the limbs and the muscles of respiration. The following table epitomizes the cases of nervous lesions among guinea-pigs observed during the past sixteen months in the laboratory among a total of 188, under observation from four weeks to several months after inoculation. These guinea-pigs received either toxin alone or else serum and toxin. The former group received a trifle less than the minimum fatal dose, the latter ten times that dose plus the antitoxin.

Of the forty-two guinea-pigs which survived the simple injection of toxin, there were represented all gradations of local changes from the merest œdema to necrosis and ulceration of the seat of injection. The table shows that four of these, or about ten per cent., became paralyzed. Of the 146 which survived the injection of the mixture of toxin and antitoxin, the local lesion was in most cases absent. Of these eight, or about five and one-half per cent., became paralyzed. In all cases of paralysis there was a local lesion, either very slight or more severe, indicating that the serum added to the toxin was not quite sufficient to neutralize the latter completely. The table furthermore shows that of these twelve cases, paralysis appeared in five cases in the third week, five cases in the fourth week, and three cases in the fifth week. In almost every instance the guinea-pig had been regarded as well and placed in a large box with other recovered animals. The paralytic lesions came on quite suddenly, usually over night. The animal was found moving with greater difficulty. The front limbs seemed to be attacked most frequently. The anterior half of the body rested upon the floor and the body was propelled by the hind feet. In one case prolonged friction with the floor of the box had produced bald spots over the sternum. When the hind limbs were affected, the body became unbal-

TABLE GIVING SUMMARY OF CASES OF PARALYSIS OBSERVED IN GUINEA-PIGS FOLLOWING THE SUBCUTANEOUS INJECTION OF DIPHTHERIA TOXIN.

NUMBER OF GUINEA-PIG.	WEIGHT IN GRAMS.	INJECTION OF TOXIN.	INJECTION OF SERUM.	EFFECT (LOCAL).	DATE OF INJECTION.	DATE WHEN PARALYSIS FIRST NOTICED.	FINAL RESULT.
519	340	Mixed Toxin, No. 44.	Horse IX.	Induration.	Feb. 10, 1897.	Mar. 11, 1897.	Recovered by March 24.
566	317	Toluol Toxin.	" X.	Very slight œdema.	Mar. 26, 1897.	Apr. 24, 1897.	Dies from paralysis of respiration Apr. 25–26.
597	339	" "	" "	" " "	Apr. 20, 1897.	May 15, 1897.	Would probably die; chloroformed May 18.
604	300	" "	" III.	Very slight Induration and loss in weight.	Mar. 26, 1897.	Apr. 24, 1897.	Recovered May 7.
851	251	Toxin No. 5.	" "	Induration and bald area.	Dec. 21, 1897.	Jan. 14, 1898.	Recovered Jan. 28.
870	294	" " "	" XV.	Œdema followed by small slough.	Jan. 15, 1898.	Jan. 31, 1898.	Unable to move Feb. 5; chloroformed.
878	258	" " "	" IX.	Induration and slight slough.	Feb. 17, 1898.	Mar. 14, 1898.	Recovered March 23.
884	254	" " "	" XV.	Thin slough.	Feb. 17, 1898.	Mar. 13, 1898.	Dies March 17.
850	257	" Lb.	No serum.	Slough and ulcer.	Dec. 27, 1897.	Jan. 18, 1898.	Chloroformed.
899	277	" 3 Pf.	" "	Large slough.	Mar. 2, 1898.	Mar. 17, 1898.	Chloroformed March 21.
905	252	" No. 5.	" "	Superficial slough.	Mar. 2, 1898.	Mar. 18, 1898.	Chloroformed; extensive paralysis.
901	277	" " 6.	" "	Slough.	Mar. 8, 1898.	Mar. 28, 1898.	Chloroformed; extensive paralysis.

anced, the animal swayed from side to side, in severe cases rolled over and gained its equilibrium with difficulty, or else remained lying down. In a few animals, respiration was affected. This became slower, sometimes labored, rarely almost convulsive. Such animals were generally incapacitated, lay on their sides and died soon or were chloroformed. In the milder forms recovery is complete in about two weeks from the date of the earliest paretic symptoms. The more severe cases die, probably of paralysis of the respiratory muscles. A consultation of the dates given in the table shows that cases of paralysis were not observed from May to December. Whether the warm season or the kind of toxin employed is to blame another year may help to explain. I am inclined to consider both elements involved. Cold weather certainly makes guinea-pigs less resistant to the toxin and the frequent occurrence of paralysis with toxin marked No. 5 points to this as in part to blame.

I have introduced these facts because they serve to illustrate once again the capacity of the toxin of diphtheria freed from the bacilli to produce lesions of the nervous system akin to those which appear in man.

While the toxin of diphtheria is thus recognizable only by what it does when injected into susceptible animals, we are not, therefore, at a loss to recognize its presence, though the process of recognition involves a great amount of labor in all investigations with it. The desire to know more definitely what the nature and composition of this substance is, is a very legitimate one, not only for theoretical but also for practical reasons. A definite chemical compound taking the place of the intangible pathogenic agent in our cultures would reduce the complex machinery needed in preparing antitoxin very greatly. Hence all toxins are now objects of research. Those of vegetable origin, such as ricin and abrin, those of animal origin, including the important snake poisons and the blood serum of various animals, and those

of bacterial origin, such as the toxins of diphtheria, tetanus and certain meat poisons, are receiving due attention; but the tendency to class these various poisons together and to apply to all of them the slight and often vague information obtained from the study of any one of them, has left the whole subject in a temporarily confused state. It is not improbable that they belong to quite different groups, and that each one must be carefully studied by itself. We need only to compare the different conditions under which the toxins of diphtheria and tetanus are produced,—the one most advantageously with the most liberal supply of oxygen, the other only when the activities of oxygen are held in check,—to realize that these products may be wholly unlike.

The toxin of diphtheria has been regarded as a ferment or enzyme by Roux and Yersin, Sidney, Martin and others. Later it was considered a toxalbumin by Brieger and Fränkel. More recently, however, Brieger recedes from that position, and regards the poison as of non-proteid nature. By an elaborate method he has concentrated and perhaps purified the poison, without however obtaining enough for analyses. He informs us that it is injured by acids and oxidizing agents, but left intact by alkalies and reducing agents. He found that after removing all the toxin from the bodies of the bacilli, these still contained a poison, probably derived from the cell substance, which produced local necrosis and death in guinea-pigs. Antitoxin had no power to neutralize this poison. Fortunately this does not figure with any importance in human pathology, as the bacilli rarely penetrate into the body in any considerable numbers.

We know that the toxin of diphtheria is a more or less unstable body. Heated in solution for several hours at 60 C., it loses almost wholly its property of producing disease. It likewise becomes weakened by exposure to air

and light. When dried it remains unchanged for a longer time. It is readily brought into this condition by adding ammonium sulphate to the filtered culture fluid. The peptones or albumoses are precipitated out and with them the toxin, which mixture is then dried in vacuo. Various other neutral salts, alcohol, and zinc chloride cause its precipitation mixed with other substances. It is also mechanically brought down when an insoluble phosphate is formed in the fluid containing it.

In the culture tube the formation of toxin is subjected to many vicissitudes. In the production of antitoxic serum of high potency, the most important condition to be fulfilled is the production of a very concentrated toxin; for the antitoxin, within certain limits, grows in strength with the amount of toxin the horse under treatment can endure. Hence, a study of the conditions under which the largest amount of toxin will appear in cultures has become the first to be entered upon. A discussion of the results of such a study upon which I myself have been engaged during the past three years would lead us too far into details which belong strictly to specialists, more particularly as they do not as yet throw much light upon the metabolism of the diphtheria bacillus or the immediate source and mode of formation of the toxin.

The toxin of diphtheria unfolds its power when introduced under the skin, directly into the blood or into the trachea. It is inert in the digestive tract. Once in the body it seems to disappear quite rapidly from the blood. According to Bomstein only one-eighth of the injected amount was found in the blood of rabbits after one hour. After five hours one-twentieth was detected. Nor was it traceable in the organs, in the contents of the intestines, or in the urine. The inference was drawn that it was destroyed by a chemical action of the tissues. Dzierzgowski believes that it is oxidized into antitoxin in the body of

highly immunized animals, a belief not generally shared at present.

The essential nature of the lesions produced by the toxin of diphtheria upon tissues and cells composing them has been the subject of many investigations. To obtain a simple morphological expression of the effect of this poison is an object worth striving for if it is indeed ever realizable. The lesions observed in the throat of patients and in the subcutis of guinea-pigs after an injection of the toxin do not reveal anything specific, and are readily ranged under the head of inflammation. The lesions observed in the cardiac muscle in the experimentally induced disease have been regarded by Comba, Mollard and Regaut and others as primarily affecting the muscle fibres. Interstitial lesions are slight and purely secondary. When we come to the nervous system to which the observed paralyses early drew the attention of histologists, a number of non-specific changes are recognizable. In the central nervous system, degenerative changes in the cells of the anterior horns have been described recently by Murajeff as following all injections of toxin whether leading to paralyses or not, but similar changes have been found by Goldscheider and Flatau for tetanus, by Kempner and Pollack for the poison of botulismus (meat-poison), and by Kossel for the poison of bloodserum from eels. The work of studying the lesions of the nervous system due to toxins has been begun in earnest and in due time this subject will become clarified. At present we are not in position to deduce from such work any simple conclusions. The peripheral nerves have also received their share of attention and the paralyses referred to a neuritis as well as to degenerative changes. Quite recently Dr. J. J. Thomas* has published interesting studies upon the degenerative changes observed in the pneumogastric nerve in those cases in which heart complications followed diphtheria.

* Boston Med. and Surg. Journal. 1898.

To these miscellaneous lesions associated with diphtheria we must add the diffuse and focal cell necroses in various organs observed by Oertel, Welch and Flexner, Barbacci, and others, and the appearance, especially in the kidneys, of peculiar cells by Councilman, denominated plasma cells, and probably derived, according to him, from lymphoid elements. In view of these various apparently unrelated phenomena, we cannot ascribe to the toxin of diptheria any specific easily recognizable effect upon the body, but must be content at present with assuming that the toxic activity embraces tissues of different orders and with variously differentiated functions, or else that it affects injuriously some one tissue incorporated with the various specialized tissues. This one tissue seems to be that composing the vascular system, and I am inclined to look upon injury to the vascular walls, especially those of the capillaries, as perhaps the *fons et origo* of the whole set of pathological changes. When the toxin is injected in very large quantities, the effect, as Barbacci* states, passes beyond the domain of the vascular system and is manifest in other tissues as well. This view does not, in any way, stand opposed to the one that diphtheria toxin is essentially a cell poison with a special affinity for the nucleus.

Moving parallel with these investigations are those forced upon us by the discovery and applicability of diphtheria antitoxin as a curative agent. The importance of accurately gauging the neutralizing power of antitoxin upon the toxin has led to much study upon the immediate relation of the toxin of diphtheria to its antitoxin. Considerable light has been shed upon the whole subject from this, the biological direction.

It will be remembered that two views of the action of antitoxins have been current. One assumes that the antitoxins stimulate the cells of the body whereby the latter

* Centralb. f. allg. Pathol. 1896. No. 8.

are put into a condition to neutralize or destroy the toxins. The action of antitoxins upon toxins is, according to this theory, indirect. The other theory claims a direct action of antitoxin upon toxins. The actual demonstration of this direct action has been attempted by various observers, but, owing to the difficulties in the way of experiments of this nature, the results are conflicting. The direct action upon toxins of their specific antitoxins has, however, been demonstrated for two other toxins, one of vegetable origin, the toxalbumin of the castor bean, ricin; and one of animal origin, the toxin in the bloodserum of the *Muræniдæ* or eels.

Ricin, which was first studied by Ehrlich, has the power to produce an agglutination of red corpuscles both in the body and in extravascular blood. In the body the clots of red corpuscles produced by minute doses of ricin lead to more or less extensive sloughing of the skin if the animal survives. Ehrlich has demonstrated the important fact that susceptible animals can be made immune to large doses of this poison by treating them with gradually increasing doses. The blood and the milk of these immunized animals possess protective powers; are, in other words, antitoxic.

Recently he has shown that the antitoxin acts directly upon the toxin in the test-tube. When ricin is added to blood, kept fluid by citrate of soda, it lumps the red corpuscles together. The masses thus formed settle down. If serum from an immunized animal be added to the blood, this clumping does not take place upon the addition of ricin. The phenomena take place under definite quantitative laws. A given amount of a certain serum neutralizes a given amount of ricin and no more.

Kossel has extended this proof by experimenting with the poisonous blood serum of eels. This serum, of which 0.1 cc. is sufficient to kill a rabbit weighing a kilogram in

three to four minutes, produces, when administered in smaller doses, emaciation, partial paralysis of the extremities, and death after several days. It dissolves red corpuscles. Rabbits can be immunized by injecting very minute doses. When eel serum is added to defibrinated, diluted blood, the coloring matter is promptly extracted from the corpuscles. If, however, some serum from an immunized rabbit be added to the blood beforehand, the corpuscles remain intact. Here also the quantity of immune serum needed is directly proportional to the quantity of eel serum used. These experiments are destined to strengthen the hypothesis that antitoxins act upon or combine with their respective toxins and thereby render them harmless. They do not, however, account for the whole process of toxin immunity into which other factors probably enter. Much more persistent experimentation will be needed to clear up the obscurity that still clings to the marvellous action of antitoxin.

To explain more consistently the various phenomena of antitoxic action, Ehrlich has formulated a very ingenious theory relating both to the mode of production of antitoxins in the body and their action upon toxins. This theory, which has been termed latterly the lateral-chain theory of immunity *(Seitenkettentheorie)*, seems to have not only stimulated researches but to have gained strength through such researches. In a recent paper* I made a very brief statement of this theory, which for the sake of making subsequent statements more intelligible I will repeat here.

If we regard the cell substance as composed of complex molecules with lateral chains, the toxin is assumed to unite with one or more of these lateral chains, thereby incapacitating the cell. This union is due to an affinity of the toxin for the cell substance, which affinity expresses itself

* The Toxin and Antitoxin of Tetanus. Boston Medical and Surgical Journal. 1898. p. 292.

to us clinically as susceptibility. If there were no affinity according to this theory, there would be no susceptibility, no disease. If only very minute doses of toxin are introduced so as not to incapacitate the cell substance too much, that part lost by union with the toxin is reproduced by the cell. The repeated injection of gradually increasing doses of poison, if cautiously done, stimulates the cell, so to speak, to an ever-increasing production of that part of itself to which the toxin becomes attached. This overproduction of a specific cell substance leads finally to a shedding into the blood stream where the shed material appears as an antitoxin ready to combine with any toxin for which it possesses definite affinities. This substance, as we know, is effective not only in the blood of the producer but in the blood of other beings into which it is introduced.

This hypothesis has been received with much interest and its general applicability will no doubt be thoroughly tested. Already Wasserman* has shown that in harmony with it the substance of the normal spinal cord and of the brain possesses well marked affinities for the tetanus toxin. This affinity is shown by the fact that a given amount of nervous tissue neutralizes a certain quantity of tetanus toxin. Thus three times the fatal dose of toxin, mixed with one-third of the finely crushed spinal cord of a guinea-pig suspended in salt solution, produces no effect when injected. The toxin, in other words, has been, in some way, neutralized by the tissues of the cord. Similar experiments carried out by Bomstein to determine those cell territories having a special affinity for the diphtheria toxin led to no satisfactory results.

Concerning the nature of antitoxins we are as much in the dark as with toxins. We know, however, that they are much more stable substances than toxins. The anti-

* Berl klin. Wochenschr. 1898. p. 209.

toxic power of blood serum from immunized animals is fairly permanent even after many months. It resists freezing and even exposure to direct sunlight for a short time. It can endure a higher temperature than the toxin without losing its efficacy. Various conjectures have been made as to its character, some claiming that it is a very specific substance, others that the antitoxic power results from a change in certain regular constituents of the blood. It is precipitable by various substances which precipitate the albumins and globulins of the blood and seems to go with them when the serum is separated in layers of different densities by freezing. Smirnow has made the claim that antitoxins can be produced from toxins by electrolysis, but his claims, at least so far as the production of an effective substance goes, seem to grow more shadowy.

When antitoxin is injected into animals, it begins to disappear according to Behring on the fourth day, appearing then in the milk and the urine. The blood contains the greater amount and it would seem that most of it, at least, remains in the blood until it disappears from the body. In horses which have been actively immunized with toxins, Dzierzgowski found the largest amount of antitoxin in the blood and serous fluids, including the œdema formed where the toxin is injected. In the organs there is comparatively little to be detected. Bomstein found that if enough antitoxin be injected into dogs to supply seven units per cc. of blood, three units were found on the third day, 1.5 on the the sixth, 0.3 on the fourteenth, and none on the eighteenth day; the organs did not absorb it, as they contained very little; similarly very little was found in the urine. These facts agree very well with the restricted period of passive immunity induced by antitoxin.

The occasionally observed toxic effect of antitoxic serum must be ascribed to a peculiar personal idiosyncrasy manifested in the presence of horse's serum. Likewise the

rashes and occasional joint affections are referable to the serum and not to the antitoxin. We are, however, fortunate in having horse's serum to use, since Uhlenhuth has recently shown that compared with the serum from a number of other mammals it is by far the least toxic of them all.

In presenting you with a large amount of miscellaneous, somewhat conflicting and but feebly coherent information upon the toxin of diphtheria and its antitoxin, I shall feel gratified if it will simply convey to you the conviction that toxins and antitoxins are realities, entities, whose obscure nature and action need not stand in the way of our belief that we have reached the right path in studying them and that we need but go on to gain, if not wider and deeper information, at least better practical results in the combating of toxic disease.

However, we still hear voices occasionally raised in medical journals against the diphtheria bacillus as the chief cause of the disease whose name it bears. This is not surprising. Clinical experience is so subject to chance and at the mercy of unknown factors that discussions of this nature are likely to appear as long as medical science shall be cultivated. The unambiguous results obtained by experimentation in the laboratory, though often too rashly applied, become more and more the guiding star of the young physician as he enters upon his profession. Laboratory work will give not only a steadiness of the judgment but also an abiding sense of the circumscription of our knowledge and of the need for its continual rectification. If the laboratory did nothing else it would amply repay to the profession and its clients the costs of maintenance.

DISCUSSION.

Dr. FRANCIS H. WILLIAMS, of Boston: The Society is to be congratulated upon the very excellent presentation of these subjects by Dr. McCollom and Dr. Smith, and I am sure, as a practitioner, I can say amen to everything Dr. McCollom has said. In 1894 I initiated the use of antitoxin in this community at the Boston City Hospital, and since then has followed the very striking change in opinion that has taken place here in regard to the use of this remedy. I recall now a number of cases where it was only with difficulty that I obtained consent to use antitoxin in patients who had diphtheria. There is still, I think, a little hesitation on the part of some practitioners, and I have no doubt that one of the things Dr. McCollom intended to do, and I think will accomplish by his paper, is to dispel any lingering doubt there may be in the minds of the profession in regard to antitoxin. Sometimes practitioners will say: "Oh, it is a mild case, we will wait." And next day it is about the same, and they wait longer. Many of those mild cases get well without antitoxin, but there are some of them that end fatally, which certainly would have recovered if the antitoxin had been used as it should have been early and without the least delay. I think there are three simple rules in regard to the administration of antitoxin: First, get a good antitoxin; second, give it early; and, third, be sure to give enough.

ARTICLE XLV.

RECENT PROGRESS

IN THE

BACTERIOLOGY OF TYPHOID FEVER.

By MARK W. RICHARDSON, M.D.
OF BOSTON.

READ JUNE 7, 1898.

RECENT PROGRESS IN THE BACTERIOLOGY OF TYPHOID FEVER.

It is nearly twenty years since Eberth, after a most elaborate series of pathological and bacteriological observations, first claimed to have established an etiological relationship between the so-called typhoid bacillus and the disease-condition known as typhoid or enteric fever. To-day we know that the claim of Eberth was justified. There are few of us, I think, however, who realize the immense amount of scientific labor which has been necessary to solve this great medical problem. To be sure, the fact that typhoid fever is, in practically all cases, associated with the presence in the body of the typhoid bacillus, has been confirmed by many observers since Eberth. Moreover, the biological characters of the new organism have been very thoroughly studied, but these observations, while extremely important and interesting in themselves, failed by far to establish incontrovertibly a specific relation between the bacillus and the disease.

The difficulties to be overcome have been many. In the first place, no animal has been found capable of developing a typhoid infection similar to that seen in human beings. To be sure, guinea-pigs, rabbits, and other animals succumbed rapidly as the result of inoculation with cultures of the typhoid organism, but at the post-mortem examination the pathological findings were those simply of a toxæmia, a septicæmia, or a combination of these two conditions,

and the production of anything resembling intestinal ulceration was of the rarest occurrence. Moreover, exactly similar results could be obtained by inoculation with cultures of the bacillus coli communis, the ordinary inhabitant of the intestine, so that the evidence of any action characteristic for the typhoid bacillus was entirely lacking. Furthermore, the resemblance of the typhoid bacillus in many of its characters to the bacillus coli communis led many to maintain that the new organism had no distinct entity, but was merely the colon bacillus altered as to its characters and virulence by external conditions.

Direct animal experimentation, therefore, failed to furnish convincing proof that the new bacillus was the specific cause of typhoid fever, and the solution of the problem devolved upon the more indirect methods pursued in studies upon typhoid immunity.

In these studies upon typhoid immunity the name of R. Pfeiffer of Berlin stands out pre-eminent, and the results obtained have been of the greatest possible interest and value.

As has already been said, the typhoid bacillus, in sufficient doses, is pathogenic for a number of the experimental animals. If, however, the animal is inoculated with small and gradually increasing doses, death does not follow, but the animal finally reaches a point where it can bear without detriment doses which would be certainly fatal to animals unaccustomed to the typhoid poison. In other words, the animal has become immune as far as the typhoid bacillus is concerned, and its condition resembles exactly that of a human being convalescent from typhoid fever or any other disease which carries, with a single infection, freedom from a future attack.

The next point of interest to be brought out was the fact that the blood of an animal made thus artificially immune to typhoid infection, when injected into a second animal,

protected the latter from the otherwise fatal consequences of subsequent typhoid inoculation.

There are, therefore, in the blood serum of typhoid immunes very powerful protective agents. They are styled by Pfeiffer "antikörper," or antagonistic bodies. They are not in the nature of antitoxines, however, but produce their curative effect by actual destruction of the bacteria themselves.

This bactericidal action was demonstrated by Pfeiffer in the following manner:

He first injected into the peritoneal cavity of guinea-pigs a certain amount of typhoid culture, and found that the organisms multiplied rapidly, finally producing the death of the animal.

If, however, he introduced together with his culture a certain amount of blood serum from an animal made immune to typhoid, the organisms, instead of multiplying rapidly, lost their motility, became clumped together, swelled up, and finally, breaking up into small granules, disappeared. Furthermore, under these circumstances the life of the animal was preserved.

Moreover, Pfeiffer demonstrated the fact that this reaction was specific; that it took place only when a special organism was treated with its own corresponding serum; that a similar relation existed between cholera vibrios and cholera serum; that typhoid serum had no effect upon cholera vibrios, and *vice versa*, cholera serum had no effect upon typhoid bacilli.

It remained only to see whether the serum of a human being convalescent from typhoid fever would not, when brought in relation with the typhoid bacillus, have protective and bactericidal properties similar to those exhibited by the serum of animals artificially immunized to the typhoid organism, and such has been found to be the case, the bacilli becoming clumped together and finally destroyed.

This specific immunity reaction of Pfeiffer has, therefore,

not only differentiated absolutely the typhoid bacillus from the colon bacillus, but also has fastened the responsibility for the disease typhoid fever upon its true cause, the typhoid bacillus.

Indeed this specific reaction has been of great use in other directions. It is the very foundation of the Widal serum test, which is now so extensively used in the diagnosis of typhoid fever.

As is now well known, this new procedure enables us in most cases to make an absolute diagnosis of typhoid fever as early as the tenth or twelfth day of the disease. In a few cases, however, the blood changes necessary for the reaction do not occur till the later stages of the malady, until convalescence, or perhaps until the occurrence of a relapse. A negative result with the serum test, therefore, carries with it little if any diagnostic value. In such cases we may have recourse to the examination of the stools for the specific bacillus, and with very fair prospect of success.

The most recent work in this line has been done by Hiss, of the New York Department of Health. Hiss has devised a special medium for the work, and has been able to isolate the typhoid bacillus in fifty per cent. of cases where a single examination of the stools was made, and in about ninety per cent. of the cases where repeated examinations were possible. The New York Board of Health now uses this method of diagnosis to supplement the serum test, and considers it of great value.

From what has been said, it is easy to see the very important part which bacteriology has played in fixing the etiology and in furthering the early diagnosis of typhoid fever; but the radiation of our knowledge of the disease has by no means been confined to these two directions. Indeed, as a result of modern investigation, we must modify very largely our conception of the typhoid process. For instance, we now know that a typhoid infection may take

place with no involvement whatever of the intestinal tract. In all these cases there had been a positive serum reaction. Such cases have been published by Guarnieri, Kühnau, Flexner and others, in which, at autopsy, the intestine was found intact, and which were, nevertheless, undoubted typhoid infections, as proved by the clinical course and serum reaction during life, and the isolation of the typhoid bacillus from the organs after death.

Furthermore, the discovery of the specific typhoid germ suggested immediately a possible etiological relation between it and the various conditions complicating or following typhoid fever, and it has been definitely shown that a considerable proportion of these associated affections are due to secondary invasion by the typhoid bacillus.

We must, therefore, in the light of our present knowledge, recognize peritonitis, pleurisy, cholecystitis, meningitis, parotitis, prostatitis, epididymitis, orchitis, periostitis, and osteomyelitis, as being in many cases essentially typhoidal in character.

In other cases, to be sure, we do *not* find the typhoid bacillus, but other organisms, notably staphylococci and streptococci, and this fact has led some observers to the belief that pus cocci are always present in these conditions at some period of the process, and that the typhoid bacilli are simply secondary invaders. The extremely elaborate experiments of Dmochowski and Janowski, however, have proved, as it seems to me, almost absolutely that the typhoid bacillus can become a pus producer, and this fact, coupled with the utter failure to find in inflammatory exudates any organism other than the typhoid bacillus, must be taken as conclusive proof that the typhoid organism is the cause of the pathological condition.

These sequelæ and complications of typhoid fever offer many points of bacteriological interest. For instance, the bile is very commonly invaded by the typhoid bacillus, and

while in most cases it causes no disturbance, in others the organism may persist for great length of time and inaugurate serious conditions and consequences. Of these conditions suppurative cholecystitis is the most common and important. Again, it has been claimed that typhoid fever is a very common precursor of gall stones, and, to explain this sequence, it has been supposed that the bacilli acted as nuclei upon which the biliary salts were deposited. This theory has gained in plausibility by the demonstration by Cushing and myself in two cases of typhoidal cholecystitis of large clumps of typhoid bacilli, such as one sees in carrying out the serum test. That these clumps of bacteria should serve as nuclei for stones certainly offers less objection than that single organisms should act in that capacity. Further, the theory receives additional confirmation from the fact that Welch has demonstrated micro-organisms in the centre of a gall stone.

As has been said already, the invasion of the bile is nearly always secondary; but that this is not necessarily so is shown by cases such as those of Guarnieri and Cushing, where the infection began in and was limited to the bile passages.

The tendency of the typhoid bacillus to persist in the body long after the original infection is ended, is well shown in the gall bladder. In a case recently reported from Johns Hopkins Hospital the typhoid bacillus was cultivated from the gall bladder in a case of gall stones seven years after an attack of typhoid fever.

Furthermore, a similar tendency to persist is shown when the urine has been invaded by the typhoid bacillus. In an article recently published I have shown that about twenty-five per cent. of the cases show bacilli in the urine; that when present the bacilli are in very large numbers, and that they may persist indefinitely into convalescence. Out of nine positive cases, two died; of the remaining

seven, the bacilli disappeared spontaneously in one,—in one the bacilli were made to disappear by irrigation of the bladder with corrosive sublimate, 1 : 7000,—and in five cases the bacilli were still present in the urines in undiminished numbers when the patients were discharged. Ten days after leaving the hospital the bacilli were no longer to be found in the urines of two patients. The three remaining cases could not be followed after discharge from the hospital. It is therefore impossible to say exactly how long the bacilli may persist in the urine. Petruschky, in a recent article, records a case where the bacilli were still present two months after beginning of convalescence.

The importance of this urinary invasion is very great in several ways. In the first place, we see that whereas in the past we have disinfected almost exclusively the stools in typhoid fever, we must now bestow at least equal, if not greater attention on the disinfection of the urine. This necessity cannot perhaps be impressed more strongly upon your mind than by telling you that in one case Petruschky calculated that each cubic centimetre of urine contained 170,000,000 typhoid organisms.

An infected typhoid urine may, however, cause trouble in another way. As I have said, we get in typhoid fever a certain number of cases of prostatitis, epididymitis, and orchitis, and bacteriological examination has often showed the typhoid bacillus in pure cultures. The probability that such inflammation is due to an ascending infection from urine containing typhoid bacilli seems to me very great. Certain it is that the only case of epididymitis occurring in typhoid fever during the past year at the Massachusetts General Hospital appeared in one of the cases with bacilli in the urine.

It is very important, therefore, if possible, to remove the organism from the urine, not only because of the danger to public health, but also to prevent secondary complications

in the prostate, epididymus and the testicle. As has already been stated, in one case irrigation with corrosive sublimate, 1–7000, caused the bacilli to disappear permanently from the urine. Recently I have been trying the efficiency of internal medication, and the results, though far from conclusive, are encouraging. Three cases have been under observation. Two were given salol alone; in one of these cases the bacilli disappeared; in the other there was no appreciable effect. The third case received at first salol, with negative result. Urotropine was then given, and the bacilli rapidly disappeared. I am thus encouraged to hope that in urotropine we have a remedy capable of coping successfully with the condition; but further trial will of course be necessary to establish absolutely its curative power.

In diagnosis the bacteriological examination of the urine could have no value except in those cases in which the serum reaction was considerably delayed, for the bacilli rarely appear in the urine until the third week, whereas, as I have said, the serum test can be applied as early as the tenth day in most cases.

Another interesting point to consider is the possibility of the existence of a true typhoid pneumonia. Several cases have been reported where puncture of the lung during a pneumonia has revealed the presence of the typhoid bacillus. Furthermore, in a single case I have been able to cultivate the typhoid organism from the sputum. Of course the mere presence of the typhoid bacillus in a pneumonic lung does not necessarily establish a causal relation between the organism and the disease process, but the coincidence is certainly suggestive.

The presence of the typhoid bacillus in the sputum offers, moreover, another possible danger to those in the environment of a typhoid patient; but the danger of infection from this source in comparison with that from the stools, and especially the urine, must be very small indeed.

As to typhoidal meningitis, we now know that such a condition is entirely possible. Especially interesting is the fact that in one case the diagnosis was made by finding the typhoid bacillus in fluid removed by lumbar puncture from the spinal canal.

A rare but interesting sequela of typhoid fever has been reported by Swiezinski in the form of a periarticular abscess under the right deltoid muscle. This abscess developed in the sixth week of the disease, and the pus revealed the typhoid bacillus in pure culture. Another rarity which may be mentioned in this connection is a case in which seven and one-half months after typhoid fever, a dermoid cyst of the oviary suppurated, and typhoid bacilli were found in the pus.

The presence of the typhoid bacillus in portions of the body, so various and remote from each other, is due undoubtedly to the transfer, in most cases, of the specific bacilli by the blood current, and, in a number of instances, the diagnosis of typhoid fever has been made from the bacteriological examination of the blood. The organisms, when found, however, are very few in number, and several cubic centimeters of blood at least are required for the test. The procedure is, therefore, quite formidable, and not likely to come into general use for diagnosis.

Finally, in diagnosis it is important to bear in mind that typhoid fever is not necessarily the only pathological condition, but may be associated with other pathological processes, notably tuberculosis. A number of cases have been recorded in which a general tuberculosis, a pulmonary tuberculosis, or a tubercular meningitis, has been complicated by an intercurrent affection, which, by the serum test and the post-mortem examination, has been proved to be typhoid.

As to a specific treatment in typhoid fever, a large number of attempts have been made to devise such a treatment, but with little success as yet.

These attempts have been along three lines. I.—The employment of dead cultures, either of the typhoid bacillus alone or combined with the bacillus pyocyaneus. II.—The employment of the serum of animals made artificially immune to the typhoid bacillus. III.—The employment of the serum of patients convalescent from typhoid fever.

As to the first method—the injection of dead cultures—it seems to me utterly and completely irrational: for, inasmuch as the typhoid poison is contained almost entirely in the bodies of the bacilli, by this proceeding we simply add fuel to the flame and do not, in the least, assist in quenching the conflagration.

As to the second and third methods—the use of immune sera—I think they give us reason for encouragement, although the results obtained thus far are not entirely satisfactory. In animal experimentation the immune sera certainly exercise great curative powers, but, as unfortunately often happens, the results of animal experimentation cannot be applied always to conditions obtaining in the human body. A number of observers have thought that they have seen favorable results from the serum treatment, but the series of cases have not been sufficiently large, nor the evidence sufficiently convincing to inspire any considerable confidence.

A number of attempts have been made to vaccinate persons against typhoid fever, and the results have been quite interesting and suggestive. In vaccination dead cultures of the typhoid organism are used, and, in this instance, as it seems to me, with some show of reason; for here we are dealing with healthy individuals, and not with those nearly overwhelmed with typhoid poison. In this process the individual is accustomed to larger and larger doses of the typhoid culture, and his blood acquires greater and greater protective power. Pfeiffer and Kolle assert that, after a single inoculation made in this way, the blood exceeds in

protective power that of a typhoid convalescent. These observers think such vaccination could be of great value in time of war, or during epidemics. As supplementing this work the experience of Tew at the Barming Asylum during the recent typhoid epidemic at Maidstone, England, is interesting. Of 84 individuals who were vaccinated all escaped; whereas, of 120 nurses and attendants unvaccinated 16 contracted the fever. The possible value of typhoid vaccination in military campaigns and during epidemics may be, therefore, great. As an every-day procedure, however, it is not likely to become popular.

To summarize: We have seen—

I.—That we can no longer doubt that in the typhoid bacillus we have discovered the essential cause of typhoid fever.

II.—That the typhoid bacillus does not necessarily elect the intestinal tract as its base of operations, but may exert its pathologic influence exclusively in other organs.

III.—That the complications and sequelæ of typhoid fever are, in many instances, due to secondary invasion by the typhoid organism.

IV.—That in disinfection the urine must be given a place equally important with that of the feces. Further, that the necessity for disinfection of the urine may continue far into convalescence.

V.—That the questions of serum treatment and vaccination in typhoid fever are, at present, largely in the experimental stage, but that the future will probably bring important advances in these two directions.

ARTICLE XLVI.

EPIDEMIC CEREBRO-SPINAL MENINGITIS.

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EPIDEMIC CEREBRO-SPINAL MENINGITIS.

HISTORY.

THE earliest epidemic of Cerebro-Spinal Meningitis which has been reported occurred in Geneva in 1805, and was described by Viesseaux. In 1806 the disease occurred in epidemic form in Massachusetts, and was described by a committee appointed for the purpose by The Massachusetts Medical Society in 1809. Since then epidemics have been described in various parts of Europe and America.

ETIOLOGY.

In 1887 Weichselbaum described a diplococcus which he obtained at autopsy from six cases of Epidemic Cerebro-Spinal Meningitis. This organism, which very closely resembles the gonococcus morphologically, he found in the protoplasm of the pus-corpuscles, and to a limited extent free in the inflammatory exudation in the meninges. The chief difference between it and the gonococcus is that it can be grown on ordinary culture media. The best culture medium is Loeffler's blood-serum. Weichselbaum called this organism the diplococcus intracellularis meningitidis.

During the last three years the diplococcus intracellularis has been found repeatedly by many other observers both in epidemic and sporadic cases of the disease.

As a rule inoculation experiments have been unsuccessful. Injections of pure cultures in the pleural and peritoneal cavities of animals have produced sero-fibrinous inflammations,

and death in some cases. Meningitis has been produced in goats, in a few instances, by injections of culture of the diplococcus into the spinal canal, and the organism has been recovered from the exudation in the meninges.

The organism appears to be very susceptible to outside influences, and it is often difficult to obtain more than a few colonies from the exudation in the meninges at autopsy. Better results are obtained when cultures are made from the spinal fluid obtained during life by means of lumbar puncture.

On culture media the organism rapidly loses its power of growth, and to maintain this power it is necessary to make fresh cultures every day. There have been no cases reported of general blood infection by this organism.

PREDISPOSING CAUSES.

There appears to be little or no influence exercised upon the spread of the disease by bad hygienic surroundings. Most epidemics have occurred in the winter and spring, and sporadic cases have been observed throughout the year. A very large proportion of all the cases have occurred between the ages of two and thirty years. Both sexes appear to be equally susceptible to the infection.

METHOD OF INFECTION.

Most observers are agreed that the disease is but slightly, if at all, contagious. The way in which infection takes place is not known. The organism has been found in the nose in some cases. The period of incubation has not been determined.

PATHOLOGY.

The lesions consist of an inflammation of the pia-arachnoid. The exudation is confined to the meshes of the pia; none is found on the surface of the arachnoid. In the most acute cases the exudation is slight in amount and purulent. In acute cases of longer duration there is more fibrin

in the exudation. The pus cells are contained in the distended meshes of the pia. Large cells, derived from proliferation of the cells of the lymph spaces and from the connective tissue corpuscles, appear. These cells are phagocytic, and often enclose numbers of the exudation cells within them. In the very chronic cases the membranes are thickened. The exudation is slight in amount, and is marked only by circumscribed whitish foci. The cells in these foci are degenerated and do not stain well. The ventricles are always distended. The ependyma is softened and frequently ragged. The fluid is cloudy and a small mass of fibrin or pus is always found in the posterior cornua of the lateral ventricles if the body has lain on the back.

The changes in the brain consist of softening and infiltration of the cortex with pus cells, which extend in from the meninges, and of foci of softening in the interior of the brain. There is also some proliferation of the neuroglia cells of the cortex. The exudation extends along the cranial nerves. The nerves most affected are the second, fifth and eighth pairs. The meninges of the cord are always affected, and the exudation is found chiefly in the meninges of the lumbar cord over the posterior surface. The inflammation extends along the spinal nerves to the spinal ganglia. The changes in the interior of the cord are not so marked as in the brain. Degenerations are found in the cranial nerves and in the spinal nerve roots.

(The above description is a brief abstract of the pathological anatomy of the disease as given by Councilman, Mallory and Wright, "Epidemic Cerebro-Spinal Meningitis," etc.—Report of the Massachusetts State Board of Health.)

SYMPTOMS.

In considering Epidemic Cerebro-Spinal Meningitis, it is very important to remember that the frequent variations

which occur in this disease depend not so much upon the presence or absence of certain symptoms as upon differences in their intensity and the period at which they occur.

Strumpell has said that perhaps the most striking feature in the disease is the constant variation in the intensity of the nervous phenomena, not only from day to day but oftentimes in the same day.

Certain symptoms which are almost constant in their occurrence are headache, pain in the neck, retraction or rigidity of the head, pain in the spine, and some degree of mental disturbance. Other symptoms which are not so constant but which occur very frequently, are vomiting, hyperæsthesia, herpes, changes in the pupils, and conjunctivitis. The moderate and irregular type of fever is very characteristic and forms a striking contrast to the severe nervous symptoms.

To obtain a clear impression of the disease, it is necessary to consider it in its entirety; the onset; the sequence of symptoms and the variations in their intensity; the peculiar temperature and pulse; and the course of the disease. The picture thus presented is characteristic, and in a large number of cases is unlike any other disease.

In order to give an adequate and at the same time a clear impression of the variations in the symptoms, the latter will be described in detail, and the different types of the disease will be briefly alluded to afterward. These types have been classified clinically as foudroyant, acute, intermittent, chronic, mild and aborted.

ONSET.

Epidemic Cerebro-Spinal Meningitis almost always begins suddenly. A number of observers have reported cases in which prodromal symptoms occurred and lasted for several days, in some cases for two weeks. These symptoms consisted of malaise; pains in the extremities and

headache. From the character and distribution of the lesions in the meninges, and from the severity and rapidity with which the symptoms develop in most cases, it is not improbable that in some of these cases, at least, the apparent prodromal symptoms were merely coincidences.

INITIAL SYMPTOMS.

The earliest symptoms are, as a rule, fever and severe headache. In quite a large proportion of cases vomiting is one of the earliest manifestations, especially in children. In a small proportion of the adult cases the disease begins with a chill, which may be repeated. Convulsions are quite uncommon in adults, but in children they are by no means infrequent as one of the initial symptoms. These symptoms will be considered in detail.

Fever.—There is no definite and constant relation between the height of the temperature and the severity of the other symptoms. This is one of the most characteristic peculiarities of the disease. Very often the temperature is moderately elevated at the onset and may remain so for several days, or throughout the disease in acute cases. If a four hour chart is kept remissions will be found to occur, oftentimes of several degrees.

Not infrequently the initial fever is very slight, although the nervous symptoms which rapidly supervene may be very severe; these cases usually occur in adults. Quite a number of cases have been reported in which there were severe headache, pain in the neck and spine, and mental disturbance, and the temperature remained normal for several days in the early part of the disease. In children, as a rule, the temperature at the onset is higher than in adults, not uncommonly 104° F. It shows the same tendency to remit as in adults. It is quite rare to find only a slight elevation of temperature in children in the initial stage. After the first few days there are usually marked irregularities in the

height of the temperature from day to day. It is rarely more than moderately elevated later in the disease, and very often the exacerbations and remissions occur independently of the other symptoms. Occasionally the temperature assumes an intermittent character for several days. There may be no parallelism between the fever and the other symptoms at these times. In the chronic form of the disease, after three or four weeks, the temperature is very apt to be normal or subnormal, with now and then slight elevations. The nervous symptoms, however, continue with exacerbations and remissions. Antemortem rises in temperature are not uncommon, but many patients die with little or no fever. The above description is by no means a complete one of the many variations which occur in the temperature, but enough has been said to indicate how little relation exists between the fever and the nervous symptoms in many cases.

Headache.—The disease almost always begins with headache. It is often very severe and persistent, and in some cases it is the most marked symptom for several days. It is rarely absent.

Vomiting.—Vomiting is frequently one of the initial symptoms, although it may not appear for a day or two. It may persist for several days, but usually is of short duration. In chronic cases it is apt to recur at intervals, and may become a dangerous symptom.

Chill.—This may be one of the initial symptoms, and may occur later with exacerbations of the disease. It is not so constant as the other symptoms, and is not common in children.

Convulsions.—Convulsions are quite uncommon in adults, but are by no means infrequent in children at the onset of the disease.

The occurrence of convulsions is by no means an index of the severity of the disease. They may occur in some

cases which are rapidly fatal, but they also occur in cases in which the disease pursues the usual course. Convulsions are rare late in the disease under any circumstances.

LATER SYMPTOMS.

Retraction of the head and pain and tenderness in the neck.—These are constant symptoms, and usually appear early. It is somewhat exceptional for them to be delayed for several days. Marked variations are observed in the intensity of the pain and tenderness, not only in different cases, but in the same case from day to day. There is the same pronounced tendency to exacerbation and remission which takes place in the other nervous symptoms. In many cases these symptoms are but moderately severe at any time, in others they are so severe as to cause opisthotonos for a time. There appears to be no constant relation between the quantity, character and location of the exudation in the meninges and the degree of pain and retraction. This has been demonstrated at autopsy, and I have examined spinal fluid which contained many organisms, and in which a purulent sediment formed in the bottom of the test-tube in a number of cases which had but moderate pain or tenderness in the neck, and only a mild degree of stupor throughout the disease. In other cases the above symptoms were very much more severe, and the fluid was only moderately turbid. In some patients the symptoms of spinal irritation are more pronounced than the cerebral.

Mental disturbance.—Some degree of mental disturbance always occurs in the course of the disease, and varies from apathy to unconsciousness. This is one of the early symptoms in most cases, and usually occurs within a day or two of the onset, in many cases in the first day. In some of the rapidly fatal cases the patients become comatose within a few hours. In some severe acute cases there may be temporary unconsciousness early in the disease, and sub-

sequently these patients may show varying degrees of apathy or stupor. Often the degree of mental disturbance is milder, and varies from apathy to stupor. Delirium is not uncommon and may assume at times a violent character. As the disease continues marked changes occur in the mental condition at short intervals, frequently in the same day.

Hyperæsthesia.—This is not a constant symptom, but is nevertheless of frequent occurrence. It usually appears at an early stage of the disease, and may occur later when there are exacerbations. It varies from moderate general tenderness to extreme sensitiveness.

Efflorescences.—Herpes occurs very frequently. The lesions are usually confined to the lips and face. Rarely they have been found on the neck and shoulders. The herpetic efflorescence usually appears between the third and sixth days and is not an index of the severity of the meningitis.

Other efflorescences are not so common, although roseola have been observed and petechiæ and ecchymoses occur at times. The latter are oftenest seen in severe cases. It would seem from the literature as if efflorescences occurred more frequently in the earlier epidemics than at the present time. It is not impossible that this may be due to greater accuracy in diagnosis at the present time.

Pupils.—Dilatation of the pupils and incomplete reaction to light occur quite frequently, oftentimes early in the disease. These conditions are not necessarily associated with lesions of the eyes and often show the same tendency to variations as the other nervous symptoms. At times the pupils are unequal.

Nystagmus.—Nystagmus is not an uncommon symptom.

Strabismus.—Strabismus occurs frequently. It may be either convergent or divergent, and appears to have no con-

nection with the severity of the disease. The condition is almost always a temporary one, and both varieties of strabismus may occur in the same patient.

Paralyses.—Paralyses are not so common as the other nervous symptoms. They may occur early in the disease, and usually affect the extremities and at times the face. Ptosis is seen in some cases. The paralyses are not often complete, and are very apt to be temporary, sometimes only lasting for a few days. Patients who have had paralytic symptoms, and who recover from the disease, rarely show evidences of paralysis at the time when they are discharged from observation. It is uncertain whether paralyses recur later in these individuals. General cerebral and spinal symptoms are much more common than localized ones.

Reflexes.—The reflexes vary a great deal. The deep reflexes may be increased, absent, or normal. There seems to be no connection between the reflexes and the severity of the meningitis.

Emaciation.—This is a constant symptom if the disease lasts longer than a week or two. In chronic cases the patients are always extremely emaciated; in some cases they are reduced literally to skin and bones.

Constipation.—Constipation is a very common symptom, and often requires periodic treatment to relieve it.

Retracted abdomen and the tâche cerebrale.—These symptoms are present in many cases, especially in children, but are of no diagnostic importance.

Urine.—The urine often contains a slight trace of albumin, and occasionally a few hyaline casts. Retention of urine is not uncommon in adults, but is much less so in children.

Pulse.—In adults there is usually a striking contrast between the rapidity of the pulse and the other symptoms. In a large proportion of cases the pulse is slower than normal in spite of the elevation of temperature and severe

nervous symptoms. This symptom is not often observed in children, in whom the pulse is often very rapid. In both adults and children there is a marked variability in the pulse-rate at different times in the day. The variations may exceed twenty or thirty pulse-beats in a minute. In cases which terminate fatally there is usually a marked increase in the pulse rate.

Respiration.—There is usually nothing striking about the respiration. It may be somewhat increased in rate, but is often within normal limits unless there is some complication in the lungs.

Spleen.—The spleen is rarely more than slightly enlarged by percussion, and is not often palpable.

COMPLICATIONS.

Eyes.—Conjunctivitis is such a constant symptom that it can hardly be considered a complication. It usually occurs within a few days of the onset. Severe lesions of the eyes are not rare. They may be caused by degeneration of the nerves, or by extension of the inflammation from the meninges into the retina and choroid. Of these severe lesions, optic neuritis occurs most frequently, and may be followed by atrophy of the disc. The inflammation of the retina may be mild or severe, and in some cases produces partial or total blindness. Some cases in which the lesions are severe recover their sight later. A few cases have been observed in which moderately good vision has been restored after some degree of atrophy of the discs. Irido-choroiditis occurs more rarely. Councilman claims that it is caused by direct extension of the inflammation from the meninges and is not metastatic in this form of meningitis. Optic neuritis may occur without showing external evidence of its presence and without much disturbance of vision.

Ears.—Lesions of the auditory nerves and internal ears are quite common, and are caused by extension of the inflammation from the meninges along the auditory nerves to the labyrinth. These lesions are severe and often cause permanent and complete deafness. Acute suppurative inflammation of the middle ear occurs quite frequently. It may be caused by direct extension from the brain, or in some cases may be produced by other pathogenic organisms which reach the ears by way of the eustachian tubes.

Joints.—There is much variation in the frequency of joint complications in different epidemics. In the epidemic in Nauplia, reported by Kotsonopolus, this complication occurred in almost all cases. In most epidemics the number was limited. The symptoms consist of acute swelling, redness and pain, which subside after a few days. The knees, ankles, wrists and elbows are the joints most often involved. In many cases only one joint is affected. But little is known of the nature of the lesions. Still claims that the disease is not in the joints, but is in the sheath of the tendons in the neighborhood of the joints. He has found the diplococcus intracellularis in one case.

Lungs.—Complications in the lungs do not occur so frequently as in the eyes and ears. Focal pneumonias are not uncommon, and are caused in some cases by the diplococcus intracellularis. In others, they are due to a mixed infection by the pyogenic organisms. Croupous pneumonia caused by the pneumococcus is much rarer than focal pneumonia.

Heart.—Lesions of the heart are very uncommon. A few cases of acute endocarditis have been reported in which the cause was not determined.

Kidneys.—Nephritis is a very rare complication.

Septicæmia.—The writer has found no record in the literature of cases of septicæmia caused by the diplococcus intracellularis.

CLINICAL TYPES.

Foudroyant cases are not very common. They appear to have been much more frequent in earlier epidemics. These cases prove fatal in a few hours—usually from twelve to thirty-six. The onset is sudden and severe, beginning with fever, headache and vomiting, and at times with convulsions, more especially in children. The initial symptoms are rapidly followed by stupor and unconsciousness. The temperature may be high; the skin becomes gray, and there are usually multiple small hemorrhages in the skin of the body and extremities. The spinal symptoms may not develop, and the clinical picture may resemble septicæmia more than meningitis.

Acute cases run their course in from two days to two weeks. Although the general type of these cases is similar, there are many individual variations. In some cases almost all of the symptoms which have been enumerated may occur; in other cases several of them may be absent. The cases differ also in the sequence and time of occurrence of some of the symptoms. There are also marked differences in the intensity of certain symptoms. Quite a large proportion of the cases show characteristic remissions and exacerbations in the severity of the symptoms at short intervals, but there still remain quite a number of cases in which exacerbations and remissions do not occur; these patients continue in about the same condition for a varying number of days, and then the symptoms either gradually subside, and recovery takes place, or severe symptoms supervene and prove fatal, or a chronic form of the disease developes.

Intermittent cases differ from acute cases in having one or several acute exacerbations with intervals of several days during which the temperature may be normal, or more or less elevated, but the cerebral and spinal symptoms disappear, and the patient appears to be convalescing. This

is followed by a return of the acute symptoms which may last for several days as before. Sometimes two or more of these exacerbations occur. The intervals between the acute attacks rarely exceed a few days, but several cases have been reported in which the intervals lasted for from two to three weeks. Some cases die during an acute exacerbation; others recover after one or more attacks; and in some cases a chronic form of the disease develops which may terminate fatally, or in recovery. Emaciation is a marked symptom in the intermittent cases.

Chronic cases begin with the usual acute onset and succession of acute symptoms. After a varying number of days the temperature subsides and may remain normal, subnormal or slightly elevated for weeks. The cerebral and spinal symptoms persist with varying degrees of severity. Sometimes the patients show little or no evidence of meningitis for several days, and then the symptoms recur. The increase in severity of the symptoms may be accompanied by rises in temperature, although the latter often remains normal, or subnormal. At times elevations of temperature occur without any marked symptoms. The symptoms are generally more or less mental disturbance; headache; pain and tenderness in the neck and spine, and retraction of the head. Emaciation is very marked. The patients usually take but little food, and gradually grow weaker. At times there is temporary improvement in the cases that end fatally. In the cases which recover there is usually a gradual cessation of the symptoms. When the disease ends fatally, death usually takes place suddenly and quietly. When lesions of the eyes and ears occur in chronic cases they do so in the early stage of the disease at a time when the acute inflammation is present in the meninges.

Mild cases may begin with the same sudden onset as the other varieties, so that in the beginning it may be impossi-

ble to determine that the disease is going to pursue a mild course. In general, however, the symptoms are milder and subside after a varying number of days.

Aborted cases are described by Strümpell as beginning with sudden and severe symptoms which rapidly subside after a day or two.

DIAGNOSIS.

Many of the symptoms of Epidemic Cerebro-Spinal Meningitis are so constant and characteristic that the diagnosis is not difficult in a large proportion of the typical cases, if one takes into consideration the whole picture of the disease: the sudden onset; the constant occurrence of cerebral and spinal symptoms early in the disease; the tendency to variation in the intensity of the nervous symptoms from day to day; the absence of correllation between the nervous symptoms and the temperature and pulse; the eye and ear complications and the frequent occurrence of the herpes. Chronic cases when seen late in the disease are the most difficult to diagnosticate, and the diagnosis may depend upon obtaining an accurate history of the onset and earlier symptoms. In several instances a diagnosis of chronic cerebro-spinal meningitis has been made by means of lumbar puncture when all other methods of diagnosis had failed. The diagnosis may be difficult or impossible in the early stage of the disease and in mild cases, without the aid of lumbar puncture. Furthermore it is important, as Councilman has pointed out, to obtain all the information possible about the different varieties of meningitis with regard to their etiology, frequency of occurrence and termination. This can only be accomplished by means of an accurate method of diagnosis, such as is furnished by lumbar puncture.

LUMBAR PUNCTURE.

When symptoms of any variety of active meningitis are present it is very rare to obtain spinal fluid in which, after standing for several hours, one cannot find fibrin or cells microscopically. In many cases it is even possible to find slight evidence of inflammatory exudation when the patients are convalescent. This method of examination fails at times, as do all methods of examination, but I believe that it does so less frequently than any other clinical means of diagnosis, such as the examination of the sputum, urine and blood; Vidal's serum test, etc. This belief is based upon work done by me during the past three years, and includes upwards of two hundred punctures. The technique of obtaining and examining the cultures, and of making the microscopic examinations of the fluid, have been systematically and carefully performed during this period. The results obtained warrant conceding a higher place to this than to other methods of clinical diagnosis. There are fewer sources of error to modify the accuracy of this test than in the others. The spinal fluid either contains cells and fibrin which denote inflammation of the meninges, or else the fluid is perfectly clear, and contains neither cellular elements nor fibrin. In the other tests various diseases or pathological conditions may give similar results, or at least so modify the results as to make a positive diagnosis impossible in many cases, in addition to the negative results which are obtained in a relatively large number of cases.

Sources of Error.—It is not necessary to describe again the technique of the operation. It may be well, however, to allude to some of the sources of error. In some cases one fails to obtain any fluid. This may be due to several causes; the needle may not enter the spinal canal; the needle may be in the spinal canal but outside the dura—that is, between the dura and the wall of the canal; the needle may be in

the sub-arachnoid space, but may be occluded by a blood-clot or a small particle of skin; the needle may be in the sub-arachnoid space, but its point may be buried in the dura on the opposite side, or the lumen of the needle may be obstructed by resting against one of the nerves. To control these sources of error it is necessary to have a wire which is large enough to fill completely the lumen of the needle. This wire of course should be sterile. If the wire is much smaller than the lumen it is likely to pass through, or to one side of, an obstruction in the lumen, and may not remove it.

If the lumen is shown to be clear by passing a wire, and a slight withdrawal of the needle does not cause the fluid to flow, then in most cases it will be found that the needle has not penetrated the dura, but is outside of it. To obviate this it is necessary to withdraw it for a distance, not sufficient for it to leave the spinal canal, and then to thrust again directing the point more towards the median line. If these various procedures be performed one will rarely fail to obtain fluid.

The chief source of error in the examination of the fluid is a reliance upon the macroscopic appearances of the fluid alone, although in many cases they are characteristic. A very slight admixture of blood will render the fluid cloudy. The quantity of blood may not exceed the fractional part of a drop, and still will produce a diffuse cloudiness. In most cases even this small quantity imparts a slight tinge of yellow to the fluid, and after the fluid has settled the blood collects in a small drop at the bottom of the test-tube. When such a small quantity of blood as this is present there is no formation of fibrin, and it is usually easy to exclude the presence of inflammatory exudation microscopically from the absence of fibrin and leucocytes. If therefore blood appears at the end of the needle it is necessary to allow a certain quantity of the fluid to escape until the

latter appears to be clear. It seldom is necessary to allow more than one cubic centimetre to escape in this way. The fluid, after this is done, is still very likely to contain a trace of blood, but not enough to interfere with the later examination. If the spinal fluid does not become clearer at once it is generally because the point of the needle is scratching the membranes, and it is necessary to withdraw it a little or to slightly alter its position. If considerable blood is mixed with the fluid there will be a formation of fibrin later.

The fluid may be slightly cloudy from particles of dust which may be in the tube, or come from the cotton at the upper part. The microscopic examination readily detects this, even if one is not certain from the macroscopic appearances.

Not infrequently larger white particles of epidermis are present in the fluid; they should never be mistaken for the very fine diffuse cloudiness due to cells.

Sometimes a faint diffuse cloudiness may be caused by the presence of bacteria and their products, in cases of septicæmia. In these cases the cultures will show the organisms, and there will be no evidences of inflammatory exudation microscopically.

Technique of examining the fluid.—The technique of the microscopic and bacteriological examinations of the spinal fluid are important. After it has stood for some time there is a formation of fibrin in cases in which the fluid is slightly or moderately turbid and a precipitation of pus when the exudation is more purulent. In some instances the quantity of the fibrin is small, and may adhere to the bottom of the test-tube. The supernatant fluid is left perfectly clear under these circumstances, and unless the fluid is carefully examined this sediment may be overlooked. It is necessary in all such cases to scrape the bottom of the test-tube with the platinum wire in order to dislodge the

fibrin. If the test-tube has been allowed to remain in a slanting position, and only a small quantity of exudation is present, it adheres to the side, and may not be noticed. This may account for some of the negative results obtained in cases of meningitis in which the fluid was said to have been perfectly clear like normal fluid. In many cases even when the quantity of fibrin is small it adheres to the bottom of the tube by its lower end, and the remainder floats in the fluid like a web. The fibrin contains the cells in its meshes.

Cover-glass preparations of the fibrin should be made; dried by passing them through the flame of a Bunsen burner, or alcohol lamp; and stained. Lœffler's methylene blue gives the best results. By means of this stain the nuclei of the cells are very clearly defined, so that the character of the exudation can readily be detected. In addition, it stains any organisms which may be present.

To differentiate the diplococcus intracellularis from other organisms, a second cover-glass preparation should be stained by Gram's method. (By this method the intracellularis diplococcus becomes discolorized.)

Cover-glass preparations may also be stained for tubercle bacilli, by appropriate methods of staining, but the organisms are so few in number that more accurate results are obtained by inoculating guinea-pigs with the spinal fluid. In cases of tubercular meningitis this produces tuberculosis in the guinea-pig in from four to six weeks.

Character of the cells.—The cells in the spinal fluid from cases of Epidemic Cerebro-Spinal Meningitis are chiefly polymorphonuclear leucocytes—"pus corpuscles." In addition there are found a varying number of small mononuclear cells—"lymphoid cells"—and large phagocytic endothelial cells. These latter cells are very large, and have large oval or round nuclei. In the protoplasm of some of them one finds leucocytes, blood-corpuscles and particles of

cell detritus. In the protoplasm of some of the "pus-corpuscles" one usually finds one or more diplococci. Sometimes a leucocyte contains large numbers of them. In this variety of meningitis the majority of the organisms are contained within the "pus-corpuscles," and are found only in limited numbers outside of the cells.

Toward the end of the disease in acute cases which terminate in recovery the "pus-corpuscles" show evidences of degeneration. The neuclei do not stain sharply, and many of the cells appear to be disintegrated. This appearance indicates that the acute inflammatory process has subsided, at least for a time, and may have some prognostic value.

In chronic cases there are fewer "pus-corpuscles." The majority of the cells have single round nuclei. Some of them are smaller than "pus-corpuscles"; have very little protoplasm, and are evidently "lymphoid cells." Others are about the same size as "pus-corpuscles," with large round nuclei and considerable protoplasm, and are probably "plasma cells." (Both lymphoid and plasma cells are present in large numbers in the meninges in chronic cases.)

Technique of obtaining cultures.—Cultures should be made on blood-serum, *at the time* of puncture, by allowing one or more cubic centimetres of the spinal fluid to drop into the culture tube. Care must be taken to prevent the fluid from running down the side of the tube at its upper part in order to avoid contamination by wetting the portion of the tube which comes in contact with the cotton. The operator should handle the end of the needle over which the fluid runs as little as possible. After obtaining the fluid in the serum tube, allow it to flow over the surface of the serum and to remain in contact with it for at least a minute or two. In a number of earlier cases in which organisms were present in the cells, and in which symptoms of active meningitis were also present, I have failed to obtain cultures by the use of a small platinum loop

filled with exudation, because the quantity was too small. Furthermore, it seems probable that in a number of cases failures to obtain a growth of the intracellular diplococcus have resulted from making cultures from the sediment after the fluid has stood for several hours, even when considerable quantities of the exudation were used.

Variations in the turbidity of the spinal fluid and their relation to the severity of the symptoms.—The following results are derived from the examination of the spinal fluid from thirty cases of Epidemic Cerebro-Spinal Meningitis. In many of these, two punctures were made at different times and in some cases three or four.

Within certain limits there is some relation between the degree of turbidity of the spinal fluid and the severity of the symptoms. The acute cases almost always show a markedly turbid fluid during the early part of the disease when the symptoms are severe. In some cases there is an immediate formation of purulent sediment in the bottom of the test-tube, but in the majority of cases the fluid is simply very turbid, and after standing contains considerable fibrin and many cells. The cases in which a purulent sediment forms may prove fatal within a few days, but on the other hand the same kind of fluid may be obtained in cases which are only moderately severe at the time when the puncture is made.

Moderately severe cases may show well marked turbidity at first, and later punctures, made at intervals of several days, may show a diminution in the turbidity of the fluid, and yet the symptoms may be severer than they were at the time of the first puncture. In other cases the diminution in turbidity may correspond to some extent with the improvement in the patient's condition. If the fluid in acute cases is obtained late in the disease, at a time when the acute symptoms have for the most part subsided, it may be clear in some cases, and the microscopic examination may

fail to detect evidences of meningitis. In other cases the cloudiness may be very slight, and very little fibrin and only a few lymphoid cells and "pus-corpuscles" may be found by microscopic examination. So that beyond certain limits there is no constant relation between the degrees of turbidity and the severity of the symptoms.

In the intermittent cases the spinal fluid may be clear during the intervals that the patient is without symptoms, and become turbid again during the exacerbations. This is by no means constant however. The fluid is very likely to show a slight degree of cloudiness in these cases in spite of the absence of symptoms.

It is impossible to say how long a slight cloudiness may persist in chronic cases. I have found more or less cloudiness due to cells in a number of chronic cases in which the disease had lasted for several weeks. From my experience thus far I would attach more importance to the results obtained by lumbar puncture than to any other means of diagnosis in the doubtful chronic cases seen late, in which even slight cerebral or spinal symptoms still persisted.

In mild cases, the exudation my disappear from the spinal fluid in a few days. In the questionable cases in which the fluid appears to be perfectly clear, it is necessary to make a very thorough examination of the bottom of the test-tube with a platinum wire, after the fluid has stood for several hours.

Relation of the number of organisms to the severity of the disease.—There is no constant relation between the severity of the disease and the number of organisms present in the spinal fluid. If cultures are carefully made *at the time* of puncture, and if the blood-serum is good, one may expect to obtain a growth of the diplococcus intracellularis in the majority of acute cases, provided the patient has symptoms of active disease. In a number of cases I have obtained a growth of the diplococcus after the disease had

lasted for more than two weeks. In one case which lasted for five weeks, I obtained growths in every one of five punctures made at intervals of one week. On the other hand there have been cases in which the spinal fluid was very turbid and in which a purulent sediment formed, and no colonies were visible on the serum after twenty-four hours, although a moderate number of diplococci were present in the water of condensation, and a very few were obtained by scraping the surface of the serum with the wire. In one such case lumbar puncture was performed three days after the onset of the disease, at a time when the cerebral and spinal symptoms were intense. In this case in addition to the very slight growth on the serum, no organisms were found in the "pus-corpuscles," although the exudation was purulent.

It is difficult to give a satisfactory explanation of such cases. It seems improbable that the organisms were dead, and therefore did not stain in the cells, or grow on the serum, three days after the onset with persistence of severe acute symptoms.

One rarely obtains a growth of the intracellular diplococcus in chronic cases. In some instances, however, a few diplococci are found in some of the "pus-corpuscles," and at times a limited number of organisms can be obtained by scraping the surface of the serum when there are no visible colonies. In mild cases the organisms are apparently not very numerous, and one would expect to obtain a negative result, so far as the cultures are concerned, unless the punctures were made soon after the onset.

SUMMARY.

1. There is no constant and definite relation between the severity of the symptoms and the degree of turbidity of the spinal fluid.

2. There is little or no connection between the number of organisms and the number of cells present in the spinal fluid.

3. In many cases there appears to be but slight connection between the number of organisms found in the spinal fluid and the severity of the disease.

4. Unless the subsequent examination of the spinal fluid is carefully performed no deductions as to the presence or absence of meningitis are justifiable.

PROGNOSIS.

It is impossible to say how long the disease will last, or what the termination will be in a given case until the lapse of a considerable interval of time during which the patient is free from symptoms. The length of this interval cannot be definitely stated, but in most cases two weeks is a safe estimate.

In acute cases it is impossible to say that the disease will not become chronic or intermittent in type later. Furthermore, the disease may be moderately severe at first and increase in severity later and prove fatal. In the intermittent type of the disease the symptoms during exacerbations may be more or less severe than those of the onset.

In chronic cases the mortality is estimated to be fully as high as in the acute variety. The patient may die from the results of the lesions produced early in the disease, or from complications, such as pneumonia, or persistent vomiting.

The mortality varies very much in different epidemics. Hirsch estimates it at from twenty to seventy per cent.

TREATMENT.

Prophylactic. — Nothing of practical value is known about the method of infection or about predisposing causes. The disease is a primary infection, and frequently attacks

apparently healthy people, therefore no definite prophylactic treatment can be formulated. Although the disease appears to be slightly, if at all, contagious, it can do no harm, in the absence of positive knowledge as to the method of infection, to isolate the patients.

Curative.—There is no known remedy which either checks the disease, or shortens its course. In a disease like cerebro-spinal meningitis in which such marked variations in the severity of the symptoms occur at short intervals, and in which so many types are observed, one must be very cautious, and not confound apparent therapeutic results with coincidences.

No effectual method of treatment has been suggested that I am aware of. The older methods, consisting of cautery of the spine; cupping; leeching; purging; ice-bags; mercurial treatment, all appear to have been faithfully tried. There is no evidence that any of these procedures accomplished anything more than to increase the patient's discomfort in some instances.

Symptomatic.—Some relief from the nervous symptoms has been obtained by the use of sedatives and analgesics. It is difficult to estimate their value in such a variable disease. Delirious and restless patients are sometimes quieted by the bromides. The pain and tenderness in the head and neck may require some preparation of opium at times. Antipyrin and allied drugs have been used, but have not proved of much value unless large doses were given. The danger to be apprehended from the depressant action of these drugs is well known, and it is safer not to use them. Salicylate of soda has been tried by various men in cases in which joint complications occurred. There is some difference of opinion as to its efficacy. In the cases which run a long course the most important indications are to sustain the strength of the patient by feeding and stimulation. It is important to keep a daily estimate of the

quantity of food taken by these patients. In the long-continued cases the patients often refuse food for several days at a time, and it is necessary to use a stomach tube in these cases at such times. This is especially the case in children.

Complications must be treated as they arise. The convalescent stage is often long, and requires careful supervision. The emaciation, weakness and anæmia demand appropriate hygienic, dietetic and tonic treatment.

In conclusion, a few words about the therapeutic value of lumbar puncture may not be amiss. The value of this procedure is purely diagnostic. One reads from time to time of recoveries from meningitis following the operation, and of other cases in which the symptoms were ameliorated. I have never seen any such cases, although constantly on the watch for them. A temporary relief, lasting for a few hours, has followed the operation in a few cases, but the same remissions frequently occur without any treatment. The fact that in almost all cases no change of any kind is visible in the patient's condition after the operation is strong evidence against its therapeutic value.

(An extensive bibliography may be found in Councilman, Mallory and Wright's work entitled, "Cerebro-Spinal Meningitis," etc.—Report of the Massachusetts State Board of Health, 1898.)

ARTICLE XLVII.

THE EDUCATIONAL TREATMENT OF NEURASTHENIA AND CERTAIN HYSTERICAL STATES.

By MORTON PRINCE, M.D.
OF BOSTON.

READ JUNE 8, 1898.

THE EDUCATIONAL TREATMENT OF NEURASTHENIA AND CERTAIN HYSTERICAL STATES.

In recommending a treatment for neurasthenia and certain hysterical states, it must be understood that reference is made to the severer types of these neuroses only;—to cases which have resisted all the ordinary methods and called for more extraordinary ones. Mild cases are usually amenable to simple procedures, like change of scene, cessation of wearing occupations and ordinary hygienic measures. As to the more obstinate cases, I think I am right in saying that we are still in need of a practical method of treatment which shall be applicable to the general run of cases. Neurasthenia differs from the organic diseases in that while on the one hand it is usually susceptible of cure, on the other it is not a self-limited disease, but may continue indefinitely, — growing, so to speak, on itself, and, like a snowball, taking upon itself bigger proportions from its surroundings.

A marked advance over all other methods was that originated by Dr. S. Weir Mitchell and bearing his name. It has unfortunately and mistakenly been called the Rest Cure. The logical basis of this method is, or perhaps was, the principle that faulty nutrition is the basis of neurasthenia, and that by curing faulty nutrition — making "fat and blood" — neurasthenic and hysteric symptoms disappeared. In the practical making of fat and blood, this primitive idea

became associated with various other principles, inasmuch as the systematic procedure upon which successful treatment depends, requires the combination of forced feeding, absolute rest, passive exercise and isolation. Rest and the other three agents are theoretically only devices to secure improvement in nutrition.

It should be noticed that by rest is meant absolute rest, so far as it is practically possible to make it. The patient is not allowed even to turn over in bed or feed herself. Passive exercise (massage and electricity) is only a device to prevent the deleterious effects in other ways, of rest, and to help the assimilation of food. Isolation is almost a *sine qua non* of the treatment; without it, the rest cure, although efficient in a certain proportion of cases, is still usually abortive in severe cases. This is a most significant fact. Now it is common knowledge that while the influence of isolation is complex, its chief mode of action is mental. This is so patent and so well recognized that I need not take the time to consider its mode of action in detail.

It is therefore apparent at once that along with the primitive idea of making fat and blood, another and essential factor has been introduced, namely, a mental one. And it must also be apparent to any one who is practically familiar with isolation in mental and nervous diseases, that the effect of mental influence can be enormously augmented or impaired according to the individuality and therapeutic attitude of the physician. As to the assumed pathological principle, — faulty nutrition, — I think there has been a growing conviction that this is not the real underlying principle of neurasthenia, and that the cures effected by the rest treatment are due to other influences, largely moral and educational, quite as much as, if not more than, to the nutritive factor. I do not believe that the observations of the best and most experienced clinicians will support the view

that neurasthenic symptoms are wholly dependent on, or caused by inanition, whether of tissue or of blood. As to my own observations, I can say that in the early years of practice, the scales occupied the more conspicuous place in the consulting room; I accepted the inanition theory with unquestioning faith, and it was a disappointment to find that later experience failed to verify it, and that too frequently the relation between weight and neurasthenic symptoms was a very loose one. It frequently turned out to be the case that with gain of weight symptoms failed to disappear; and with equal frequency, perhaps, that with good nutrition marked neurasthenic symptoms were present. It became evident that some other principle was at work as a causative factor than that of insufficient nutrition.

I find this conclusion now amply verified by a review of my cases observed during the last fifteen years, and it seems to me also to have been recently verified by a very valuable study of "The Relation of Neurasthenic Conditions to the General Nutrition," by Dr. Robert T. Edes.* Dr. Edes, as a result of a systematic study of his cases, has arrived at what seems to me similar conclusions; that is to say, Dr. Edes concludes "that no plan of treatment which affords a prospect of anything like enduring success can afford to leave . . . . wholly out of sight" the improvement of the nutrition. "So far as body-weight, which, of course, depends upon the harmonious work of more than one function, is concerned, by far the greater number of my cases seem to fully confirm the popular view. In the great majority a steady gain in body weight went hand in hand with improvement in nervous symptoms." But this im-

* The Relation of Neurasthenic Conditions to the General Nutrition, with reference to *(a)* Body-weight; *(b)* Blood-Measurements: *(c)* Excretion of Urea, Uric Acid, Indican. By Robert T. Edes, M.D., of Jamaica Plain, Mass. Transactions of the Association of American Physicians. Vol. XII. 1897.

provement, it should, I think, be pointed out, occurred in a sanitarium where it is to be presumed there were the conditions of rest and isolation as coöperative factors. On the other hand, he found special groups of cases which were partly incompatible with these ideas, and which went to show "that although the two processes of improved general nutrition and returning nervous strength do go so nearly hand in hand, they are not one and the same, and it is not always easy to say which leads." I think it is quite as much the case that improvement in nutrition is an accompaniment of improvement in health and an index of such improvement, as it is the cause. As a state of health begins to return, the body takes on increase of weight.

The fact may be fairly stated to be that the relation of nutrition to health is a general and not a specific one, and just about what every one has known from time immemorial, namely, that people in good health are usually well nourished, and when they begin to break down they lose flesh and gain again when they improve. Conversely, poorly fed and nourished people break down more easily than well nourished people. They cannot stand the strain or do the work required of them any more than can a poorly fed horse. So, impaired nutrition undoubtedly plays a part in neurasthenia, but it is a coöperative part and not the only or primary one. Neurasthenic symptoms may exist with or without malnutrition; unquestionably, imperfect nutrition tends to increase and encourage fatigue, and fatigue tends to perpetuate symptoms. When malnutrition is present, fatigue is more easily induced, and in fatigue symptoms are more easily excited and tend to persist, habit symptoms are less easily broken up, automatic symptoms continue, and the tendency to relapse and to a return of former symptoms is greater. As Dr. Edes says, we cannot afford to leave wholly out of sight the principle of malnutrition.

I think it would be approximately correct to say that the

neurasthenic state is primarily one of fatigue, and that as a rule it is more easily brought about when malnutrition exists, and that when malnutrition comes on secondarily, as is apt to be the case, it is more easily cured when the nutrition is restored. But increasing the quantity of fat and blood does not necessarily cause the nervous system to react normally or remove the condition of "fatigue." It does not necessarily increase the quantity of the hypothetical energy-holding compounds in the cells. Making fat and blood bears the same relation to the act of curing symptoms, that using steam and horse-power does to hand labor; it makes the work more economical, easier and quicker, but it also, and here the analogy ceases, it also makes the result more permanent. We may not hesitate, then, to accept formally what most of us think, that the assumed physiological principle, that the neurasthenic state is caused by faulty nutrition, is unsound. The introduction of the device of absolute rest in the treatment — for it is a device to aid the purpose of improving nutrition—does not in any way strengthen the malnutrition principle.

More important than the supposed scientific principles upon which any particular treatment is based, are the practical results which are obtained by it. That the rest treatment has been successful in experienced hands, and especially as practised by its distinguished originator, must be accepted, irrespective of any contrary results that may have fallen to the lot of individuals. For myself, I can bear testimony, if at this late date this were necessary, to the brilliant results which have followod Dr. Mitchell's treatment of cases of which I have had personal knowledge. I feel myself indebted to Dr. Mitchell for undertaking the care of a number of severe cases which have always returned to me to bear witness by their restored or improved health, to the skill of this eminent physician. Undoubtedly there are other members of the profession in whose hands the rest

cure has given perhaps equally satisfactory results. In its general plan it has been adopted with more or less thoroughness in probably all sanitaria for nervous diseases in this country, and has had an influence upon the general practice of the profession, which can be paralleled only by the late discoveries in bacteriological medicine. To its influence we probably owe the development of a large number of sanitaria which of late years have sprung up throughout the country.

Nevertheless, even if all this be true, there have been certain drawbacks, and I may say ill consequences of the method, and certain difficulties in carrying it out, that make a reinvestigation of the treatment of neurasthenia desirable.

The objections and outs of the treatment may be briefly stated as follows: (A) While we must recognize that the treatment has been brilliantly successful in the hands of certain individuals, nevertheless it has been a failure in the hands of others. It is not a treatment which is calculated to give equal results independent of the personal qualifications of the physician; this largely because its fundamental principle has been wrongly interpreted and therefore the treatment itself has been too often improperly carried out. (B) Many cases which are distinctly curable, and which later were cured by other methods, have failed to be cured by the rest cure, although systematically employed. (C) It too often happens that patients improved by this method fail to stay well, but promptly relapse as soon as they are again exposed to their old environments and the wear and tear of life. (D) Many patients far from being cured are made distinctly worse and become more confirmed invalids than ever. The rest cure not only makes use of improved nutrition but employs the most powerful of all therapeutic agents in neurasthenic and hysterical conditions, to wit, every moral influence that can be

brought to bear by means of change of surroundings, isolation, active physical manipulation of the body, and the personal influence of the physician. When this moral influence has been lost sight of, and reliance has been placed by the physician upon the mere physical details of the treatment, looking mainly to the increase in nutrition for the therapeutic effect, the result is apt to be a failure. Under such conditions in fact I do not hesitate to say that the rest cure has done much harm; a result which, as I have said, has been due to a misunderstanding of the real principles involved. When a patient has been for a considerable period of time secluded and absolute rest has been enjoined, and when after the prescribed period the expected freedom of symptoms has not been obtained, I think that as a rule, a distinct injury has been done the patient; pathological habits of the nerve centres have been strengthened, new morbid associations formed, and the symptoms have become more firmly rooted and more difficult to dispel. In fact, the symptoms are worse and the neurasthenic or hysterical state more fixed. Under such conditions the tendency is to prolong the rest, hoping for an improvement each week, and at the end of each additional week of rest the matter is made worse. In other words, rest and seclusion under such conditions tend to cultivate and strengthen neurasthenic and hysteric habits, and the last state of that person is worse than the first.

Mere improvement of nutrition cannot be relied upon to remove neurasthenic and hysteric symptoms. Mere rest alone, without isolation, without improved nutrition, without strong moral influences, will not do it. Under such a rest it is the too common experience, that so far from being removed, they become more persistent then ever or, even when they disappear, they at once return after restoration to the environment. For this reason I am of the opinion that the rest cure is a method that, when not

properly understood in its real underlying principles, is capable of doing the greatest harm, and I do not hesitate to say that it is a most dangerous method in inexperienced hands. I say this not as a mere unfounded generalization or impression, but as a logical induction from an enumeration of quite a number of cases which I have seen in private and hospital practice, treated unsuccessfully by this method.

Finally, a practical objection to the rest cure, even when it would otherwise be effective, is the expense.* In some cases this practically debars many patients from its benefit, so that for this reason alone it is desirable that we should have some effective method applicable in most cases.

What method, then, can we suggest to take its place? I am perforce compelled in a paper of this kind, to limit myself to certain general principles.

The method of treatment which I have practised during the past eight or nine years with satisfactory results and which I now bring to your notice, is what may be termed for want of a better name, the Educational Treatment, combined with mental therapeutics and physical hygiene. The general mode of procedure may be summarized as follows:

First. Instruction of the patient in the nature of the symptoms and disease.

Second. Fixed ideas, apprehension and erroneous beliefs counteracted; faulty habits of temperament and character corrected.

Third. Individual symptoms suppressed by electricity, suggestion and other therapeutic agents.

Fourth. Rules given for the daily conduct.

Fifth. Improvement of nutrition, moderate rest, and, in extreme cases, isolation from previous surroundings only.

* Properly carried out it involves the cost of board and lodging in a first-class boarding-house or hotel for two persons, patient and nurse, for a period of six or eight weeks, with one or two months' further sojourn in hotels at the sea-side or country. Then the cost of electricity and massage (sometimes extra), the wages of the nurse and the physician's charges for daily attendance all mount up to several hundreds of dollars.

I will briefly consider each of these principles, taking them in a somewhat different order than I have done.

Isolation. Perhaps the first question in the treatment is to determine how far is isolation necessary. If by isolatation is meant not only the separation of the patient from all former surroundings, but a restriction of all intercourse to only the nurse and physician for any considerable period of time; if this is meant by isolation, then I doubt extremely whether it is necessary or desirable in any class of cases, unless it be a few exceptional cases of severe hysteria. Separation from previous surroundings and associations, and particularly not only from all members of the household but from the house itself, is always beneficial and a great help in the treatment. I believe this to be one of the strongest moral therapeutic agents, and as potent as perhaps any factor in bringing about a cure. When therefore there are no financial or other difficulties in the way of obtaining a limited isolation of this kind, I would always advise it as a great help, but it does not seem to me that absolute isolation is desirable. On the contrary, I would strongly advise the systematic development of new associations and the encouragement of new thoughts and new mental and physical habits, which are best brought about, not by complete isolation, but by bringing the patient in active contact with the new world in which she is brought. Some cases require a change of surroundings more than others. The more marked the mental symptoms, the more hysterical, the more emotional the character of the disability, the greater the necessity for a separation of this kind, and a change of all external influences. In some extreme cases such a separation is absolutely necessary and any attempted cure is useless without it. It is for this reason that patients do better when they go under a physician's care in a distant city than when they are even under the best of treatment in their own place of residence. The familiar associations

of even the streets and acquaintances work for harm, while new scenes, new streets, strange people are strong mental factors for good. But practically it is only feasible for a limited portion of neurasthenics to be removed from their homes, and we therefore have to take the conditions as we find them. Fortunately such separation, although a great aid, is not absolutely necessary in the great majority of cases, and therefore the rule I would lay down is, "Procure separation only where feasible in moderate cases, and insist upon it at all costs in the extreme and worst cases." A nurse is not required excepting in the worst cases.

Education and Mental Therapeutics. The next part of the treatment, and at the same time the one that is most difficult and interesting, is what I call the education of the patient. It is upon this that we must rely for the suppression of the individual symptoms, the acquisition of strength and the development of habits of body and mind that will enable the patient to return to the wear and tear of life without breaking down. The preliminary step in the treatment is the study of the origin, history and groupings of individual symptoms. It is surprising to find, after a searching enquiry which involves every detail concerning the origin and character of the symptoms, and the conditions under which they arise, how often what seems to be a mere chaos of unrelated mental and physical phenomena will resolve itself into a series of logical events, and law and order be found to underlie the symptomatic tangle. By such a study we can determine what symptoms are pure habit symptoms of the kind which Dr. Taylor to-day has already described and of which he has given us examples; what symptoms are pure manifestations of hysteria; what are due to faulty ideation or auto-suggestion; what fatigue is due to real physical exhaustion and is true fatigue and what is false fatigue; what pains are due to the diffusion of effort and association and what are due to some real underlying

physical cause; what symptoms are due to real disease of organs like the heart or stomach and what to mimicry. After unravelling the symptoms in this way it will be surprising to find how much facilitated will be the removal of them.

For example: Miss D. had what ordinarily would be called neurasthenia, but what I prefer to call hysterical neurasthenia, of two years' standing. Her general neurasthenic condition was easily cured in a few weeks, but there persisted for almost a year after being otherwise well, a pain in the left lower abdominal region. This she had had for two years. She had had various kinds of treatment, gynecological, electrical and drugs without benefit. The pain was of sufficient intensity to cause considerable distress. Careful physical examination by an eminent gynecologist and myself failed to find any physical reason for it. Finally a searching enquiry previously neglected showed that the first appearance of the pain was after the introduction of a pessary which had to be removed on account of pain and discomfort. The present pain and discomfort are exactly the same in character as that originally caused by the pessary. It is not continuous; it is relieved by exercise and by conditions that would aggravate any local pathological process. The conclusion is then reached that it is a habit neurosis originally excited by the pessary and now continued by sub-conscious ideation and habit. The explanation is accepted by the patient and a cure rapidly follows.

Mrs. R. suffers from neurasthenia which has been unfortunately diagnosed as lead poisoning. Fatigue is a prominent symptom; she is capable of very little physical exertion, being able to walk perhaps a block. Enquiry shows that her treatment has forced upon her the impression that there is some distinct but mystical disease of the nervous system caused by lead, and she has been unconsciously educated to have fatigue after exertion. Every time she

attempts walking she is apprehensive of doing permanent damage. The fatigue is thus shown to be false fatigue and easily cured by mental therapeutics and hygiene, so that in a week or two she takes quite long walks, etc.

Mrs. D., an extreme case of hysterical neurasthenia, suffers from extreme dyspepsia and an abdominal neurosis or paræsthesia. Careful investigation shows the dyspepsia to be mostly false and to be really a hyperæsthesia of the stomach of probably the same pathology as is the common photophobia of the eyes in neurasthenia. The abdominal neurosis is also found to be of a similar character. The same patient was a notorious sufferer from headaches. These after analysis are shown to begin with true megrim and then to pass into hysterical headaches. The key to the multitude of symptoms exhibited by this patient almost always can be found to be *apprehension* or auto-suggestion.

Mrs. S. suffers from attacks of tachycardia, palpitation, and syncope if she attempts to go out doors. She has been educated to believe she has heart disease, although careful examination by a prominent physician showed nothing organic. These attacks cease when the true nature of them is explained, viz. apprehension and expectation.

Miss V. This was one of the worst and most inveterate cases of cerebro-spinal pain in a neurasthenic of seventeen years duration, that I have ever seen. From the pain and general fatigue she had been incapacitated for seventeen years and deprived of almost all participation in the ordinary affairs of life. A careful study of the original conditions of occurrence and other peculiarities of the pain showed conclusively that it was an association or habit neurosis. It finally yielded to prolonged and persistent educational treatment.

The second preliminary step is the study of the personal characteristics of the patient, with a view to determining

what part mental influences have in the symptoms, and to obtaining the coöperation of the patient. Further, a person who is sensitive, whose feelings are easily wounded, ready to see personal reflections in any criticism of his or her habits, must be very differently treated from one who is throughly open-minded, not sensitive and indifferent to criticism, and ready to coöperate in the treatment without regard to personal considerations. This coöperation is a very important factor. The attitude of the physician should be largely that of the trainer to the athlete. He is to teach the patient how to help himself.

Having gained the patient's confidence and coöperation, the rules I would lay down are these: First, remove all interfering mental states that prevent the subsidence of symptoms; these are: (*a*), a fixed idea or belief in the seriousness of the condition and the existence of real organic disease. (*b*), a belief in the danger or incurability of the state. (*c*), a fear or *apprehension* that any harm can come to the patient from incautious actions, like exercise and doing various things. (*d*), sub-conscious fixed ideas or memories producing hysteric symptoms.

One of the commonest hampering mental states is a belief on the part of the patient that doing things that bring on symptoms, are likely to produce serious harm. Most patients do not mind disagreeable feelings so much as they fear that anything that produces them might do them serious and lasting harm. A patient, for example, refuses to go about not because he minds fatigue, but because he thinks that fatigue means serious damage. Another fears to move because of cardiac symptoms, which he imagines or has been told indicate heart disease, but does not mind them if he can be assured and really believe there is no cardiac trouble. It is surprising sometimes to see the almost immediate beneficial effects produced by the mere acceptation of the idea that symptoms do not mean disease

or lasting injury. With the acceptation of this idea, symptoms sometimes subside at once.

The next point is the instruction of the patient in the meaning of symptoms. The patient should be allowed to understand the cause and meaning of each discomfort; for example, when symptoms are pure habits, due to association of ideas and actions, when fatigue is a false or habit fatigue this should be explained. It is my habit to give a great deal of time to this instruction. It is important to take the patient into your confidence and explain the nature of such symptoms as if one were explaining to a colleague; and above all, when the case is of hysteria to say so frankly, and not conceal the fact but explain its nature. Next, when tendencies to emotional states exist, states of anger at trivial things, anxiety, fear, worry, nervous shocks, accompanied as these usually are by somatic symptoms, to educate the patient to control and suppress all such emotional states. Here tact, character and individuality on the part of the physician come in.

Suppression of individual symptoms by appropriate therapeutic agents.—Now comes in one of the most important parts of the treatment, namely, the daily suppression of individual symptoms by proper therapeutic agents. Symptoms should, if possible, be suppressed as fast as they arise without being allowed to gather headway and grow, in order that faulty habits and reactions of the nervous system may be broken up at once. It is preferable that the patient should make visits to the physician's office rather than the reverse. When a patient makes a pilgrimage, as it were, for the distinct purpose of being alleviated, the effect of the treatment is generally heightened. For the suppression of symptoms, one of the most valuable therapeutic agents, and one which I find myself making use of more and more in practice, is direct suggestion. This occupies a very prominent place in every case. It may be used in

various forms and for different purposes. As to the form which is used, I have rarely of late been obliged to resort to the hypnotic state, but have obtained all the influence that I have needed in a waking state, using for the purpose static electricity where it can be had; the faradic or galvanic battery will sometimes answer. At the same time that the electricity is applied the suggestion is given, and the patient is instructed in the nature and cause of her symptoms and disease, and what is to be expected. In a waking state, a suggestion is more efficacious if given symbolically so to speak, through some material agent. I myself rely almost entirely upon some form of electricity. I would not overlook the purely physical effect of electricity in neurasthenia. I believe it has a physical influence especially in suppressing painful feelings, and removing fatigue sensations. I would therefore make use, at one and the same time, of both influences, the mental and the physical. In some cases the physical and in some cases the mental influence predominates. To illustrate, a patient is directed to come daily at first to the physician's office. The patient's symtoms, we will say, are headache, insomnia, backache and fatigue. The static douche and sparks are used, the present and future effect expected insisted upon; if possible the patient is not allowed to leave until some, or complete relief has been obtained. The beneficial effect of drugs should not be neglected. Often sedatives like bromide are valuable. Gouty and rheumatic tendencies should be corrected, and the diet carefully regulated of course when dyspeptic symptoms exist.

My plan is to take each symptom individually in turn, no matter in what part of the body it may be, and by appropriate therapeutic agents to endeavor to dispel it as fast as it appears.

In some but rare cases of hysteria it may be necessary to go down to the lowest strata of consciousness, and for this

purpose the hypnotic state may be necessary. One advantage of hypnosis in such cases as this, is that in this state we can often learn from the patient the causes and origin of symptoms which in the waking state are forgotten. For example, Miss F. suffers from attacks of pain in the left side, with various other symptoms, coming on under peculiar circumstances. It is related in hypnosis that they all date from a certain episode involving an emotional shock. The psychical character of such pains is at once demonstrated, and their removal facilitated by suggestion. Many such instances might be cited.

A further value of hypnotic suggestion is that you are sometimes able to make in the hypnotic state criticisms of the patient's habits which will be resented in a waking state. Ordinarily hypnosis is not necessary. Besides suggestions directed to the individual symptoms, others should be given directed to the state itself. For example, that there is no real disease at all, only a lack of harmony in the working of the system, according to the view taken by the physician, always being particular to state the truth and exactly what the physician believes. Suggestions should also be given to counteract fixed ideas, fears, apprehensions and expectations of the patient, and by such suggestions to anticipate future accidents that may arise.

Avoidance of artificial cultivation of symptoms.—Just as education is a most potent factor for good, it may have an equal influence for evil. Caution is therefore most desirable against unintentionally suggesting all sorts of possible evil consequences that may result either from the actions of the patient or from the disease. The physician should be cautious against suggesting himself, or allowing others to suggest, either directly or by innuendo, that fatigue, pain, insomnia, or any discomfort, will be likely to supervene under certain circumstances, and above all that any real lasting injury can be done the patient by any effort

of any kind. This does not mean that rigid rules of conduct should not be prescribed; on the contrary they should be, but it should be done with intelligence and judgment. I have seen more than one neurasthenic whose symptoms have been the pure result of unintentional cultivation.

Next, educate the subject's body and nervous system to do whatever it cannot do without symptoms. An educational process of this kind is the same as that which is used in teaching a person in any of the arts or sports. If a person cannot walk without fatigue, he must be taught to do it. If he cannot go to the theatre without pain, he must be taught to do it. If he cannot put food in his stomach without distress, particularly when this distress represents a feeling of dyspepsia, the stomach must be taught to bear food without resulting discomfort. This is the opposite of the system which would suppress every action which cannot be accomplished without discomfort. Some physicians, I find, have a habit of restricting a patient from doing whatever cannot be done without pleasure and comfort. The result of this is that the symptoms tend to grow and increase until finally the restriction must be proportionately increased. For example, a patient who cannot walk without fatigue, a fatigue that is evidently false, if cautioned too severely, and restricted, will eventually end by becoming confined to the house and thus to the bed. If the coöperation of the patient is obtained as above, this is unnecessary.

Finally I would say, in regard to the educational part of the treatment of neurasthenia and hysteria, it is most important that a methodical regularity of life should be enjoined, almost each hour of the day being filled up by the physician. This both for its moral and physical effects. To summarize once more the daily educational treatment:

First.—Instruction in the nature of the symptoms and disease.

Second.—Fixed ideas, apprehension and erroneous be-

liefs counteracted, faulty habits of temperament and character corrected.

Third.—Individual symptoms suppressed by electricity, suggestion and other therapeutic agents.

Fourth.—Rules given for the conduct during the succeeding twenty-four hours.

Food and Nutrition.—When faulty nutrition exists of course it must be corrected on general principles of health. We cannot expect permanent robust health with endurance for bodily activity so long as the body is underfed. For this purpose my plan has been to give five to six raw eggs daily in addition to the meals, one between each meal and one immediately after each meal on leaving the table, and one at bedtime. The eggs are to be swallowed whole without the yolk or albumen being broken. This is a trick easily acquired. Any other form of nourishment may be substituted, but this is the most practical. Increase of weight, it must be remembered, is an adjuvant or coöperative factor, not the end sought.

Rest.—A certain amount of rest *must be given*. What amount of rest is required? Absolute and continuous rest I have of late years rarely used, excepting in cases that are already more or less bed-ridden. I find it not only unnecessary but a distinct disadvantage in the majority of cases. The only advantages are: First, the moral effect. This may, if properly made use of, be great; but I cannot help thinking that the same moral effect can be obtained in a more straightforward way by appealing directly to the intelligence of the patient. Second. When severe dyspepsia is present it enables us to get along with smaller quantities of food while we are educating the stomach to take larger quantities. The disadvantages are distinct. (A) At the end of a period of four or six weeks we have, in addition to the fatigue of the disease to contend with, the weakness from prolonged rest. (B) It tends to cultivate habits of fatigue and other ner-

vous symptoms after effort. (C) Absolute rest requires the constant attendance of a skilled nurse, whose qualities are not easy to obtain, and the more continuous attendance of the physician. (D) It requires massage and electricity to counteract the deleterious effect of rest. (E) It taxes the ingenuity of the physician to fill up the time. (F) We lose much time in beginning the educational treatment of the patient, in teaching self-control and breaking up faulty habits. (6) It is unscientific and unnecessary.

But some amount of rest above that of a night's sleep a patient must have, and for this reason: there is a limit to the endurance of every person. The average person perhaps finds eight hours' sleep sufficient, giving sixteen hours to the wear and tear of life, or fatigue-producing occupations, including pleasures. Of these sixteen, nine can be used for actual work and the remaining seven for recreation, exercise, feeding, etc. But the seven thus spent are also fatigue-producing hours. Now the essence of neurasthenia is a lack of endurance and easily induced fatigue, with delayed recuperation, so that a neurasthenic, instead of being able to give sixteen hours, can only spare eight or ten to fatigue-producing occupations. It is therefore necessary to cut down the day hours during which a neurasthenic is exposed to the wear and tear of life, including pleasures. Now when fatigue has been produced it does not matter whether it is true or false fatigue—the patient is incapacitated for further exertion. I have always found it useless to push patients when this point is reached; if it is done the result has almost always been disastrous. The patient can be educated or trained but not pushed, just as an oarsman can be trained to do a double amount of work but he cannot be pushed at first beyond his strength.

The rule I would make then, is this. Divide up the day into alternate periods of rest and occupation. See that sufficient rest is given, taking the peculiarities of the

individual case into consideration; and having done this, see that the occupation periods are utilized in training the body and mind. Instead of absolute rest then I would insist on the opposite or active use of the nervous system for certain periods of time. It is important that the hours of the day should be actively filled up with little time left on the hands of the patient.

The principle is, see that enough rest is given, and being satisfied of that, see that the remainder of the time is spent in education and training, and provide as much hygienic occupation as the patient will stand. If a neurasthenic cannot sit up ten minutes, she can one, which will soon become ten. If she cannot drive twenty minutes she can ten.

ARTICLE XLVIII.

THE ANTITOXIN TREATMENT OF TETANUS.

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READ JUNE 7, 1898.

THE ANTITOXIN TREATMENT OF TETANUS.

THE rarity of Tetanus, although it is perhaps a reason why comparatively little attention is given to its study, should not detract from our interest in a disease so sudden and severe in its manifestations, so frequently fatal, and presenting in regard to its treatment so many features which tax the skill and resources of the surgeon to the utmost. With sudden and treacherous onset, following a slight and frequently disregarded wound, it attacks its victims like lightning out of a clear sky. Its progress is frequently so rapid that when the surgeon first sees his patient he is compelled to recognize the probable hopelessness of his efforts. The surgeon who has, if only once in his life, been called upon to treat a case of tetanus, will from that moment feel an interest in the disease, which will not be diminished by its rarity, and he will be fortunate if his interest is not attended by dread.

The fact that tetanus is far more frequent in tropical climates, and that it results oftener from wounds received in war than those in civil life, gives added interest to its study to us as Americans in view of the fact that we are even now engaged in the conquest of Cuba under the heat of the tropical sun.

Almost the only result of all the investigation which has been devoted to tetanus, has been an increase in our knowledge of prophylaxis, and this fact doubtless accounts for the rarity of the disease in civilized communities at present. This prophylaxis has not resulted, however, from

efforts directed especially to the prevention of tetanus, but has resulted from the antiseptic method, primarily directed against the bacteria of suppuration, and incidentally resulting in the expulsion or prevention of growth of the tetanus bacilli in wounds.

As to the treatment of the fully developed disease, however, until late years all our study and effort have failed to do more than mitigate the symptoms, while they have not diminished the mortality. In the hands of the most experienced clinicians and of tyros and quacks, the great majority of the acute cases have continued to die, and a small majority of the slowly developing, or chronic cases, to get well—no effective specific treatment having been discovered.

During the past few years, however, since the discovery by Kitasato of the prophylactic and therapeutic value of the antitoxic serum of tetanūs in animals, a new hope has been held out to us that the much needed specific remedy for this disease in men might be soon elaborated. The entire success of the antitoxic treatment of diphtheria, and the enormous saving of human life which has resulted therefrom, have fostered the hope that in tetanus the results might prove equally brilliant. Various antitetanic serums have now been employed in the treatment of tetanus over a term of seven years. Have the results shown that an effective agent against the disease has been provided or not? Is the antitetanic serum to be relied upon in the treatment of tetanus at all, and if employed is it to be used to the exclusion of, or in conjunction with the older methods? To answer these questions as far as is possible in the present state of our knowledge is the chief aim of this paper.

To decide as to the value of the antitoxin treatment by the comparison of statistics is even more difficult in tetanus than in other diseases. The individual experiences of any one man, or even of any single institution, within the few

years that the antitoxin has been available for use, are too small to render possible such a comparison on a large scale of statistics as proved of such great value in establishing the position of the diphtheria antitoxin. Then the variability in the strength of the preparations employed, the great difficulty of determining the strength of almost any preparation, and the difficulty of deciding upon the dose which should be administered in any given case—all contribute to render the statistics of little value. In regard to this last point, I think it can be demonstrated that in the vast majority of reported cases in which the serum has been employed, it has been given in absurdly insufficient doses.

The problem of dosage in the antitoxin treatment of tetanus is complicated at the very start by certain very stubborn properties of the tetanus toxin. The first and perhaps the most important of these is the fact demonstrated by Dönitz in rabbits, and by Nocard in horses, that the amount of antitoxin necessary to neutralize the tetanus toxin in the body, grows enormously with the amount of time which has elapsed between the introduction of the toxin and the antitoxic serum. If an hour has elapsed between the administration of a fatal dose of toxin and that of the antitoxic serum, twenty-four times as much serum will be necessary to prevent the death of the rabbit as would have been required if the toxin and antitoxin had been introduced at the same time.

Nocard found in horses that the intravenous injection of large doses of antitoxin is insufficient to prevent the death of horses poisoned by the toxin, if the remedy was not given till after the appearance of the prodromal symptoms of tetanus. An injection twenty-four hours before the appearance of the symptoms was not sufficient, — in order to save the life of the animal it was necessary to make the injection at least forty-eight hours before the prodromal symptoms appeared.

A small dose of the antitoxin is sufficient to prevent tetanus in horses if given a very short time after the animal has received a dose of toxin which is invariably fatal to control animals. The later the injection the larger the dose required, and the more unfavorable the probable results.

The explanation given by Dönitz for the large increase in the dosage of antitoxin made necessary by the lapse of time after inoculation with the poison is that the moment the tetanus poison enters the blood it begins to enter into combination with the tissues; that as time elapses, this combination becomes firmer, and accordingly, increasingly large doses of the antitoxin are necessary to free the antitoxin from the combination and neutralize it.

In whatever way we attempt to explain it, the fact that in horses by the time the symptoms have developed it is too late to hope to save the life of the animal by antitoxin is a stubborn one to an advocate of the curative power of the serum in fully developed tetanus. Fortunately, however, for our hopes in regard to the antitoxin treatment in man, we find that we are dealing with somewhat different conditions. The appearance of tetanic symptoms, which is the very first possible moment at which we can begin the treatment of the disease, is by no means the signal that a fatal dose of toxin has been absorbed. The inoculation in human tetanus takes place by the introduction of the spores into a wound, under conditions favorable to their growth. We have no way of mathematically estimating the amount of toxin which has been absorbed at the time the symptoms develop, but we have plenty of evidence to show that it is not always a fatal amount, and that in all probability it varies greatly. If in human tetanus the development of the symptoms signalized the absorption of a fatal dose of toxin, the mortality of the disease would be 100 per cent. instead of about 60.

A very brief study of the clinical histories of tetanus

cases will indicate that in certain cases, probably those in which large numbers of the bacilli are introduced, and in which the local and constitutional conditions are favorable to their rapid development, the disease comes on soon after inoculation, develops rapidly, tremendous poisoning of the system takes place, the symptoms are severe and unremitting, and death generally ensues.

In another class of cases the symptoms come on late, and progress slowly, owing to the small number and slow multiplication of the bacilli and gradual absorption of the toxin, and we know from statistical evidence that in this milder class of cases, the death rate has been only about 40 per cent., as compared with 80 to 90 per cent. in the acute cases.

A long period of incubation, however, does not always mean a mild or chronic case of tetanus. It is reasonable to suppose that the bacilli introduced into a wound may remain latent, or that though they multiply rapidly, the conditions for absorption of the toxin may be unfavorable. At a later period, perhaps owing to disturbance of the wound, or other cause, they may invade a larger or more absorbing area of tissue, vast amounts of the toxin may be discharged into the blood, and a rapidly fatal, acute tetanus may result. Such cases are properly classified as "acute," rather than chronic cases, whereas a classification based merely on the length of the incubation period, would place them among the "chronic" or mild cases: the rapidity of the course of the disease and the severity of the symptoms should be considered in the classification of tetanus cases as well as the length of the incubation period.

The incubation period and rapidity of onset varying thus, in case of the usual method of infection by spores or bacilli introduced on foreign matter into wounds, we would expect a variation in the results of antitoxic treatment. This variation has been found by Dönitz and Knorr to hold true

in the case of guinea-pigs. Dönitz found that of six guinea-pigs inoculated by splinters of wood bearing tetanus spores, four showed symptoms forty-five hours after inoculation and two fifty-three hours. All were given 5 ccm. of antitoxin (10% solution) and three of the four died.

In order to estimate the possible value of the antitoxic serum, we must briefly summarize the statistics of the treatment up to the present time, and analyze them, as far as possible, according to the efficiency of the preparation, the dosage, and the period of the disease at which the treatment was begun. In order to arrive at any approximation to the truth, a severe method of criticism must be adopted, such as that of Kanthack, which was adopted by Lambert in his excellent article on the subject, published in the New York Medical Journal, June 5, 1897.

His estimate of the mortality of tetanus previous to the antitoxin treatment was about 60 per cent. for all cases—80 per cent. for the acute, and 40 per cent. for the chronic. He had collected up to May, 1897, one hundred and fourteen cases treated by antitoxic serum, with a mortality of 40.35 per cent. Six cases being thrown out for lack of sufficient data, we have left 47 acute cases with 35 deaths; a mortality of 74.46 per cent.; of the chronic type, 61 cases with 10 deaths, a mortality of 16.39 per cent.

Excluding cases which died of intercurrent diseases within twenty-four hours after treatment was begun, and also all mild cases which did not receive treatment till the 10th or 15th day of the disease, we have left 31 acute cases with 19 deaths, or 61.2 per cent. mortality; and in the chronic cases, 40 cases with 38 recoveries and two deaths—a mortality of five per cent. This will leave a total mortality of 29.57 per cent. in 71 cases.

From the literature of the subject during the year which has elapsed since Lambert's article appeared, I have been able to collect and analyze 43 cases, and to add to these

five cases personally communicated by Lambert, treated with the New York State Board of Health antitoxin, and five cases treated with the Massachusetts State Board of Health antitoxin — two at the Boston City Hospital (previously reported by the writer), two recently reported by Dr. Homans (Boston Medical and Surgical Journal, June 2, 1898), and one acute case treated with antitoxin at the Boston City Hospital by Dr. Abner Post — making 53 cases in all.

Of these, 33 recovered and 20 died — a total mortality of 37.5 per cent.

They may be divided according to the criteria given above into 29 chronic, of which 4 died, a mortality of 13.9 per cent.; and 24 acute, of which 16 died, a mortality of 66 2-3 per cent. Now excluding cases, which for the reasons given above cannot be fairly reckoned, we find we must omit of the chronic cases one which died and seven which recovered, leaving 21 cases with 3 deaths, or 19 per cent. Of the acute cases, we must exclude one case which recovered and five cases which died, leaving 18 cases with 11 deaths, or 61.1 per cent. This gives of selected cases 39 with 14 deaths, or 35.8 per cent., as compared with Lambert's 29.57 per cent.

Adding my selected cases (39) to Lambert's (71), we get a total of 110 cases, with 38 deaths, or a mortality of 34.5 per cent., an improvement on the average estimated mortality of 60 per cent. without antitoxin treatment.

Adding my unselected cases (53) to Lambert's (114), we have a total of 167 cases with 54 deaths, or about 39.5 per cent. mortality.

Against the value of these statistics may be alleged the fact that possibly more successful than unsuccessful cases have been reported, and that it may be questioned whether it is right to throw out acute cases dying within twenty-four hours of the beginning of treatment. These rapidly

progressing cases are included in the pre-antitoxin statistics, which we use for comparison. Unless the antitoxin can in these acute cases neutralize enough of the toxin within twenty-four hours to save the patient, it is of no value in their treatment. It is questionable to exclude cases which certainly seem of importance in deciding the question of the value of the treatment. If these cases had been included five fatal acute cases would have been added to my list, and have sensibly increased the acute mortality.

According to these computations, although the statistics collected by the writer have been somewhat worse than Lambert's, we find that the cases treated with antitoxin have shown a mortality about 20 to 25 per cent. less than the computed average mortality of 60 per cent. in cases not treated by serum.

In view, however, of the difficulty of estimating the previous mortality, and the probable unsoundness of our estimate, we must call to our aid other criteria for judging the results of the treatment. The next question which we should ask for this purpose is: Has any definite amelioration of the symptoms followed the administration of the antitoxic serum?

We are compelled to anwer that in the majority of reported cases no evidence of relief of symptoms, following immediately or early upon the injections, was noted; and in fact, we find in only seven of the fifty-three cases a distinct mention of relief of symptoms following the injections. In a few cases, increase of symptoms is stated to have followed the injections.

In the cases which recovered under the treatment, although naturally a rapid or gradual improvement took place, it could not in most of the reports be connected directly with the injections.

Dangerous results which could be ascribed to the serum I have not seen reported. Many of the cases have grown

worse, and certain have died soon after the serum injections, but in a disease which progresses so rapidly as tetanus, and is so capricious in the matter of relapses and recrudescences, it is impossible fairly to attribute these instances to the serum and not to the disease.

A review of the results of serum treatment up to date, then, shows by statistics, for the fallibility of which many reasons may be alleged, a probable moderate diminution in the mortality rate, while marked relief of symptoms cannot be shown to have been a result of its use. On the other hand, it cannot be proven to have done any harm, and in fact the bulk of evidence goes to show that it is harmless.

Has it demonstrated itself worthy of further trial? We have seen that in the hands of many physicians, using many preparations, so far as we can judge from statistical evidence, the mortality has been slightly decreased under its use. Has the application of the treatment been so intelligent and efficient as to enable us to say that it has had a fair trial? Have the preparations employed been of sufficient strength, and have they been employed in sufficient doses to achieve adequate results? The answer must be an emphatic negative.

The preparations used have been of varying and unknown strength, and even in cases where reliable preparations have been used, the dosage has been insufficient. Excellent authorities have miscalculated the strength of antitoxic serums. Lambert, as pointed out by Dr. Smith in his article on Toxin and Antitoxin of Tetanus, has estimated the strength of the serum produced by the New York State Board of Health, at 40 to 70 times its actual strength, and made corresponding deductions as to the dose. The dose proposed by Lambert has been shown to contain from 40 to 60 antitoxic units, instead of 8,000,000, as he estimated. Under such conditions it becomes especially difficult to determine what dose of a given pre-

paration to employ, for it is evident that strength of the serum must be known in order to determine, as far as possible, how much will be needed to offer any hope of success.

The strength of tetanus antitoxic serum is estimated in "units," so called, of antitoxin. What is an antitoxic unit? It has been defined by Behring and Knorr as the amount of antitoxin which will neutralize 100,000 minimum fatal doses of toxin in a 250 gramme guinea pig, when injected at the same time with the toxin. A man weighing 100 pounds is about 180 times the size of a 250 gramme guinea pig. Therefore, provided the minimum fatal is the same per gramme of body weight, it will require 180 units to protect the man, if it is given at the same time as the toxin.

But in the treatment of tetanus in rabbits and horses we have already alluded to the enormous increase in the dose made necessary by the lapse of time since the injection. Behring has stated that not less than 500 units should be injected as the initial dose. Probably the initial dose should be even higher than this, and in the end it may prove a mechanical impossibility to inject enough serum to save an acute case.

With regard to the Massachusetts State Board of Health serum, at the time it was first put on the market last spring it contained ½ to 1 unit per cubic centimetre, according to Dr. Smith's estimate. Therefore, in order to administer 500 units, we should have to give as the initial dose at least 500 cubic centimetres. It will not suffice to give this amount in divided doses in 24 hours. In order to afford any promise of neutralizing the toxin in the blood, this large dose must be thrown at once directly into a vein. Experimenters have shown again and again the necessity of throwing the antitoxin into a vein in order to get anything like a quick or definite result, and yet in only a very small num-

ber of cases has this method been adopted in practice. For effective treatment an antitoxin somewhat stronger than that furnished by the State Board of Health would be desirable, as an initial dose of 500 cubic centimetres, or about a pint, is certainly inconveniently large, and would necessitate a severe drain upon the supply. Dr. Smith last winter stated that with the continued treatment of the horses with toxin and eventual drying up of the serum, a stronger antitoxin would become available in this state, and I have no doubt that by this time it has become possible to supply a stronger serum.

Of the serum furnished by the New York State Board of Health, at the time Lambert's paper was written, about 250 c. c., or eight ounces, would be required as the initial dose, according to Behring's standard. Now in what doses have the various preparations been given? In single doses, generally of from 10 to 20 c. c.; the largest single doses which have been given have been 100 c. c. of the State Board of Health in the second case treated at the City Hospital, and 120 c. c. in Dr. Homan's case. In both of these cases the initial dose was smaller, in one 40 c. c. and in the other 60 c. c.

The list of cases treated by the Massachusetts State Board of Health serum now consists of four acute cases, all of which died, and one of moderate severity, which recovered.

Dr. Lambert writes me that in the last year he has had four acute cases die under treatment with the New York State Board of Health antitoxin, and one moderately severe case get well, which is exactly the same record as in Massachusetts.

Has any antitoxin been produced of sufficient strength to promise practical results in the cure of manifest tetanus?

Behring's dried preparation, containing 100 units in one gramme of powder, which may be dissolved and injected, is

the strongest yet put upon the market. It is supplied in 5-gramme powders, which contain therefore 500 units.

Behring's liquid serum, which he supplied before the dried preparation was put upon the market, contained 25 units in five c. c., so that of this preparation 100 c. c. would contain 500 units. Have the results with Behring's stronger serum, which we must concede has provided in most effective form for suitable dosage, shown an improvement over those of other antitoxins? (München. Med. Woch. 1897, xliv. 880.)

Engelmann in August, 1897, had collected five cases treated with Behring's dried serum, three of moderate severity and one severe case had recovered, and one very severe case had died. To these may be added an acute fatal case reported by Suter, and a mild case which recovered, by the same author. With regard to Behring's liquid serum, five units to the cubic centimetre, Engelmann had collected 13 cases, of which seven had recovered and six died.

The strength of Tizzoni's serum, which was one of the first to be dispensed, and the most extensively employed in Europe, I have been unable to ascertain.

Engelmann had collected 36 cases treated by this serum with only eight deaths. Only five cases had shown no result from the injections. Engelmann had employed in doses of from 12 to 30 c. c., and had had personally three successful cases of medium intensity.

In estimating the value of antitoxin in tetanus, another question remains to be answered, namely: whether the fact that sedatives have been employed in conjunction with antitoxin would effect the value of statistics.

In studying reports of cases, we note comparatively few in which the tetanus antitoxin has been used alone. It has usually been combined with a free use of the old symptomatic treatment with sedatives,—chloral, bromide, morphine, and where necessary, chloroform inhalations. This fact in no

wise affects the validity of our estimate of the antitoxin treatment, for these remedies are purely symptomatic, and do not attempt, as does the antitoxin, to directly attack the disease. They have no prejudicial effect upon the antitoxin treatment, and in view of the fact that the latter rarely controls the spasms, we should not be justified in compelling our patients to do without their assistance, even in cases where it is employed.

The promotion of free diuresis by every possible method should also be practised in the treatment of tetanus, since it has been demonstrated that the kidneys are the principal channel for the elimination of the toxines.

IMMUNIZATION BY SERUM.

If any one fact with regard to the tetanus antitoxin has been demonstrated with absolute unanimity by investigators, it is that immunization is possible with comparatively small doses. Nocard, who has demonstrated the futility of the antitoxin treatment in veterinary practice, has had entirely favorable results with preventive inoculations.

It would not be by any means an unwise precaution to employ a prophylactic injection of 10 to 20 c.c. of tetanus antitoxin in cases presenting lacerated and dirty wounds, which have perhaps first come under observation several days after their infliction, or in which, though seen early, thorough primary disinfection is at first impracticable. This will hold true in particular in tropical climates, where tetanus is known to be more frequent, and in the case of wounds received in war, which are especially liable to present favorable conditions for tetanus infection, and in which facilities for thorough primary disinfection are frequently not at hand. An adequate supply of antitetanic serum might well be included in the medical stores to be furnished to the United States army in Cuba.

PROPHYLACTIC TREATMENT OF THE INFECTIVE FOCUS.

The means ordinarily employed by surgeons in the treatment of dirty, lacerated and punctured wounds, are directed primarily to the destruction or washing out of the ordinary pathogenic bacteria, and to the removal of dead or vitally injured tissue, and to securing thorough drainage. The rarity of the occurrence of tetanus in this vicinity is sufficient evidence that these measures are under the ordinary conditions efficient for the prophylaxis of this disease. Under certain conditions, however, we should not lose sight of the fact that the ordinary surgical antiseptics are not the most effective in their action upon tetanus bacilli. Solutions of bicholoride of mercury, 1-1000, require three hours' contact to destroy tetanus spores, and a 5 per cent. solution of carbolic acid requires fifteen hours' contact. The addition of half a per cent. of hydrochloric acid to the 1-1000 bichloride solution kills the spores in 30 minutes.

A 1-1000 solution of silver nitrate destroys the spores in five minutes. Bichloride of mercury is entirely inactive against the tetanus toxin. The iodine preparations, iodine trichloride, Gram's and Lugol's solutions, are the most effective agents we have, acting both upon the bacilli and the toxin, and should be freely used in wounds suspected of infection with tetanus, since beside being antiseptic they destroy the toxin already found.

CONCLUSIONS.

1. Although the statistics of the antitoxin treatment of tetanus up to the present time, apparently show a diminution in the mortality under this treatment, they may be legitimately criticised as on the whole insufficient in total number, in definiteness of reports, and as probably not including all fatal cases treated.

2. The more carefully we study them, the less evidence do we find that the antitoxin treatment, and not the mild

course of the disease, was responsible for the favorable course in the cases which have recovered. There is no satisfactory evidence that harm has resulted from the injections.

3. There is a distinct probability that in the great majority of the total number of cases treated the dose of antitoxin, especially the all important initial dose, has been too small to have any possible effect upon the disease.

4. The treatment in view of the present untractibility of the disease demands further trial.

5. There are certain means by which we can hope to make it more effective, and these include earnest efforts on the part of those engaged in the production of serum to secure a stronger product, and on the part of those who employ it in treatment to give a sufficiently large initial dose, and to give it at the earliest possible moment. The serum should be injected directly into the blood stream.

6. The strength of the antitoxic preparations furnished by the Massachusetts and the New York Boards of Health, when first supplied, was so slight as to render it necessary to employ 500 c.c. as the initial dose.

7. A valuable field for the use of antitoxin lies in its employment for immunizing purposes.

8. The treatment of tetanus, according to our present knowledge, should consist of:—

a. Thorough disinfection of the primary focus by mechanical means, including, if necessary and practicable, amputation.

b. The thorough local employment of such chemical antiseptics as have been shown to destroy both the bacilli and the toxin.

c. Symptomatic treatment by sedatives, etc.

d. Thorough diuresis.

e. Intravenous injection, at the earliest possible moment, of an amount of antitoxic serum which shall contain at least 500 antitoxic units.

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ARTICLE XLIX.

THE QUESTION OF THE CURABILITY OF CANCER OF THE BREAST.

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READ JUNE 7, 1898.

THE QUESTION OF THE CURABILITY OF CANCER OF THE BREAST.

THE great change which has been wrought by the extension of the field of operation in cancer of the breast, and the improved technique of the operation introduced from time to time and more noticeably of recent years by Halsted, give renewed interest to statistics in this operation as they continue to accumulate.

The contrast between the rare successes of former years and the present time I have already called attention to in a recent paper.*

As the value of statistics is increased with the number of cases tabulated, it has seemed to me worth while to review the situation after an interval of two years and to endeavor to glean whatever there may be to throw light upon the great question: In how many cases may we hope eventually to save life on the lines on which surgeons are now working?

The accompanying tables include seventy-two cases covering an interval of fifteen years. It does not include all cases operated upon during that period, as the histories of many of the earlier cases could not be obtained, and many cases had to be thrown out, owing to imperfect pathological records.

* Boston Medical and Surgical Journal, Nos. 12, 14, 1896.

No.	Date.	Diag.	Recur; Date.	Alive and Well.	Death, Date and Cause.
1	July, '83	Colloid	July, '88, nodule, axilla removed	May, '95	
2	June, '84	Cancer	O	'93	Jan., '94, with apoplexy.
3	Dec., '84	Scirrhus	O	April, '97	
4	Mar., '85	Cancer (recur)	Feb., '94, in scar, removed	Mar., '98	
5	July, '85	Cancer	O		July, '91, with "sporadic cholera."
6	Nov., '86	Med. ca.	March, '89, local		? No answer.
7	Jan., '87	Cancer	April, '87, local		?
8	Feb., '87	Cancer	May, '88, removed, and again later.		Oct., '89, with recur.
9	Mar., '87	Cancer	O	Mar., '97 Mar., '98	
10	Oct., '87	Med. ca.	Local and general		Aug., '88, with recur.
11	Dec., '87	Med. ca.	Sterum and general		Sept., '90, with recur.
12	Jan., '88	Med. ca.	June, '89, local		Jan., '90, with recur.
13	Feb., '88	Scirrhus	April, '88, local		Aug., '88, with recur.
14	Oct., '88	Cancer	O	Mar., '93	
15	Oct., '88	Scirrhus	Not locally		Aug., '91, with recur.
16	Jan., '89	Med. ca.	At autopsy		Dec., '92, with recur.
17	Jan., '89	Med. ca.	Feb., '89, local, removed. Feb., '90, local, removed		? No answer.
18	Jan., '89	Cancer	Nov., '89, local, removed		Sept., '91, with recur.
19	Feb., '89	Cancer	O	Mar., '98	
20	Feb., '89	Med. ca.	General		Sept., '90, with recur.
21	April, '89	Med. ca.	5–6 mos., local		July, '90, with recur.
22	Aug., '89	Scirrhus	3 mos., local		Nov., '89, with recur.
23	Nov., '89	Cancer	May, '90, local, removed. Oct., '90, hopeless		May, '91, with recur.
24	Nov., '89	?	After 2 yrs., local		May, '95, with recur.
25	Dec., '89	Cancer	Other breast after 9 mos., quack. Recur. scar.		May, '93, with recur.
26	Jan., '90	Cancer	Autumn, '92, local. April, '93, general		Aug., '93, with recur.
27	Jan., '90	Cancer	O Local		Feb., '91, with recur. (?)

No.	Date.	Diag.	Recur; Date.	Alive and Well.	Death, Date and Cause.
28	Mar., '90	Scirrhus	Local		Oct., '90, with recur.
29	Nov., '91	?	O Local(?)		May, '92. ?
30	Feb., '92	Med. ca.			Oct., '92.
31	Oct., '92	Med. ca.	June, '93, local		May, '94, with recur.
32	Nov., '92	Cancer	June, '93, local		June, '94, with recur.
33	Nov., '92	Cancer	O	Mar., '98	
34	Jan., '93	Med. ca.	Nov., '94, local, removed	Jan., '98	
35	Jan., '93	Scirrhus	Jan., '95, local and general		? No answer.
36	Feb., '93	Cancer	O	April, '98	
37	April, '93	Scirrhus	O	Mar., '98	
38	June, '93	Scirrhus	Local and general		Mar., '94, with recur.
39	June, '93	Med. ca.	Local and general		Mar., '94, with recur.
40	Sept., '93	Scirrhus	O	June, '98	
41	Jan., '94	Med. ca.	July, '94, local		June, '95, with recur.
42	Jan., '94	Scirrhus	O	Mar., '98	
43	Jan., '94	Scirrhus	Wound never healed		July, '94, with recur.
44	Feb., '94	Med. ca.	General		July, '97, with recur.
45	Feb., '94	Scirrhus	In spine		Aug., '95, with recur.
46	Feb., '94	Med. ca.	General		June, '94, with recur.
47	Feb., '94	Med. ca.	March, '94		April, '94, with recur.
48	July, '94	Med. ca.	March, '97, local removed May, '98, local		
49	Oct., '94	Scirrhus	Jan., '96, local, removed		Mar., '96, with recur.
50	Nov., '94	Med. ca.	Aug., '95, local, removed Oct., '96, hopeless		?
51	Dec., '94	Scirrhus	?	May, '95	?
52	Jan., '95	Scirrhus	O	Mar., '98	
53	Jan., '95	Cancer	O	Mar., '98	
54	Mar., '95	Scirrhus	O	Mar., '98	
55	April, '95	Med. ca.	Feb., '96, local, operated(?)		April, '97, with recur.
56	Aug., '95	Med. ca.	June, '96, local, operated. July, '97, inoperable		

No.	Date.	Diag.	Recur; Date.	Alive and Well.	Death, Date and Cause.
57	Sept., '05	Scirrhus	O	Mar., '98	
58	Oct., '95	Scirrhus	O	Mar., '98	
59	Nov., '95	Med. ca.	Immediate. Operated?		Jan., '96, with recur.
60	Dec., '95	Med. ca.	?	Nov., '96	?
61	Jan., '96	Med. ca.	May, '96, local		Mar., '97, with recur.
62	Jan., '96	Med. ca.	O	Mar., '98	
63	June, '96	Scirrhus	O	Mar., '98	
64	Oct., '96	Med. ca.	O	Oct., '97	
65	Oct., '96	Cancer	?		Dec., '97, with recur.
66	Dec., '96	Med. ca.	?		June, '97, "suddenly."
67	Jan., '97	Med. ca.	Jan., '98, local, removed	Feb., '98	
68	June, '97	Med. ca.	O	Jan., '98	
69	Nov., '97	Med. ca.	May, '98, stenum and humerus		
70	Dec., '97	Cancer	?		
71	Jan., '98	Carcinoma	O		Jan., '98, pulmonary embolism. 5th day.
72	Feb., '98	Med. ca.	O*	April, '98	

Of the 72 cases there are 26 known to be alive at the present time, and 38 known to have died. Of the latter there were, however, two cases in which death occurred of other diseases than cancer, and that too long after the danger limit had been passed. In other words, nearly half of the cases are known to be living to-day, or to have died of other disease than cancer.

Of the 26 living cases there are 3 who now have recurrence of the disease, and 4 who have had a recurrence but remain well at the present time.

The following table shows in a general way the locality of the relapse:

* O in recurrence column signifies "none."

RECURRENCES.

	LOCAL.	GENERAL.	DOUBTFUL.	HUMERUS AND STERNUM.	TOTALS.
Dead,	25	7	3		35
Alive,	1	1		1	3
Unreported,	4		4		8
Alive and well,	4				4
Totals,	34	8	7	1	50

The above table shows the great importance of a careful study of the proper limits of the field of operation, for we find that in the 50 cases in which recurrence took place there were 34 local recurrences and only 8 in which the field of operation remained in a healthy condition.

Such statistics emphasize the importance of strict attention to the rules now laid down, viz.: the removal of a large margin of the cutaneous covering of the breast, a careful deflection of the edges of the wound, and removal of the subcutaneous fat for a considerable distance around the mammary gland, the removal of the pectoral muscles, and a minute and painstaking dissection around the sheath of the axillary vessels.

In only one of the successful cases was there a dissection of the supraclavicular glands. I have, however, four times operated upon the neck of a patient for infected glands, in which case the original operation field has remained healthy for four years. I feel confident that had the supraclavicular region been explored at that time a small gland would have been discovered, and a permanent cure would have been secured.

It is my custom at the present time to explore the posterior cervical triangle in all cases, and although in the majority I fail to find disease, this addition to the operation does not appear to add to its danger or to the amount of shock.

In regard to the situation of the growth we find that in 25 cases no statement is made as to the locality. This leaves 47 cases. In 13 of these the disease was found in the upper and outer quadrant, in the upper and inner quadrant in 6 cases; in the central region in 6 cases; in the upper hemisphere in 5; in the lower and outer quadrant in 5; in the outer hemisphere in 3; in the inner hemisphere in 1.

These figures show that the disease is most frequently found in the upper and outer quadrant than in any other quadrant, in the upper hemisphere more frequently than in the lower hemisphere, and in the outer hemisphere than in the inner hemisphere.

In two cases the disease originated on the anterior axillary fold and I have named this in a class by itself as "Cancer of the anterior axillary border," the disease apparently beginning as in Paget's disease in the skin, and subsequently involving the breast.

The periods during which recurrences are observed are also of value, and they are given in the subjoined table. In nine cases it was not possible to learn the date of recurrence, but of the other 41 cases 37 occurred during the first 3 years; of the remaining 4 cases 2 recurrences are found between 3 and 4 years, and 2 between 5 and 9 years. One of these exceptionally late recurrences was a colloid cancer in which an axillary gland evidently had been overlooked. In the case in which a nodule was removed from the pectoral region nine years after the original operation, it seems reasonable to assume that a new infection had taken place in a para-mammary gland. The existence of these glands is now well recognized by anatomists, and the fact shows the importance of including all such adjacent gland tissue in the field of operation.

This table also shows how rare are the recurrences after three years.

It seems to me highly probable that many cases, reported as unusually late recurrences, are cases which have not been carefully examined. The patient's word has been taken when suddenly a generalization of the disease reveals the true condition. Every case should receive a thorough examination by a competent surgeon at the end of three years. If under these circumstances the report is favorable, there is probably not more than one chance in a hundred that the disease will ever show itself again.

RECURRENCES: Before

	½ yr.	1 yr.	2 yrs.	3 yrs.	4 yrs.	5 to 9 yrs.	?	Totals
General	2		2	2	2			8
Local	11	11	5	3		2	2	34
Doubtful							7	7
Humerus and Sternum	1							1
Totals	14	11	7	5	2	2	9	50

Taking the three years' limit as the gauge of success, we find there are seventeen such cases. Two of these are dead; one dying, ten years after the operation, of apoplexy, and one dying of sporadic cholera six years after the operation. Three of these have had recurrences, one in the axilla and two in the pectoral region. These nodules were removed, and the patients are now alive and well, one of them three years, one four years and one ten years after the last operation. Of the remaining twelve the operation was performed in three cases over three years ago; in four cases over four years ago; in two cases over five years ago; in one, over nine years ago; in one, eleven years ago; and in one case over twelve years ago.

An analysis of the diagnosis in these seventeen cases shows that nine were reported to be cases of "cancer," six reported as cases of "scirrhus," one medullary cancer and one colloid cancer.

With one exception only the cures consist of the milder forms of cancer if we assume that the term "cancer" indicates a condition midway between scirrhus and medullary.

It is somewhat discouraging to find that only one case of genuine medullary cancer has been rescued from the lot. In this case there was a recurrence in the pectoral region two years later which was successfully removed, the patient since remaining well for over three years. The clinical history of the case bore out therefore the original diagnosis and showed it to be correct.

The percentage of cures, or those which have passed the three years' limit, in fifty-five cases, is 30.9%.

In estimating these results it should be remembered that these operations extend over a period of fifteen years, and that the earlier operations do not compare with the later ones in thoroughness. They do, however, cover that period in which the axilla was dissected in all cases, but of the earlier operations not much more can be said than this. If now we begin with January 1st, 1893, and take in all those cases which come up to the three years' limit, that is up to April, 1895, or just three years ago, we find twenty-two cases with eight cures or a percentage of cures of 36.3%.

A large number of these cases include those of hospital patients, many of them of malignant types, and patients who have delayed calling attention to their disease. If now we take the cases in private practice only, during this same period we find they are twelve in number with six deaths, one recurrence, and five cures, or 41.6%. On the other hand, taking all the cases in private practice during fifteen years we find the percentage 34.7 %.

Comparing these figures with those given in statistics, collected by Dowd,* we find 199 cases, with 71 cures, or 39.6%. This percentage seems remarkably high for so large a series, but it includes Rotters' series with 50%, including only fifteen cases, and Cheyne's with 57%, including only thirty-three cases.

* Annals of Surgery, March, 1898.

It is possible that some surgeons include those cases only in which an operation gives a chance for cure, selecting those in which they have advised a radical operation with the distinct view to a permanent cure. In my own series those cases only have been omitted where the entire growth could not be removed, such operations being clearly only palliative.

It is evident that high percentages can be obtained only when cases are selected with some care, but present experience with the new operation hardly justifies one as yet in deciding what are the limits of the curable class. Until then many incurable cases will undoubtedly be subjected to operation. It seems at least a more humane policy to sacrifice our statistics for the sake of saving occasionally a desperate case.

On the other hand, it is to be hoped that wider experience will enable us to spare many a patient the ordeal of a useless operation. It should be said here, however, that even in palliative operations life is prolonged and suffering often spared to a remarkable degree.

In regard to causation. In eight cases only is trauma given as a probable cause of the disease. In four cases there was a history of abscess, and in two cases a history of mastitis.

The question of the involvement of the axillary and supraclavicular glands is one of great practical interest. The record mentions glands felt in the axilla in fifty-four cases only. My impression is that in one or two cases only has a careful search by the pathologist failed to unearth infected glands in this region. In five cases supraclavicular glands are mentioned. Three of these cases are dead, one is alive, and in one the result is unknown.

In only fifteen cases is there a record of a retraction of the nipple. In my opinion this is a most unreliable symptom.

One often sees an inversion of the nipple which is quite a different condition, and one quite frequently associated with anatomical peculiarities. It has no pathological significance.

There may be extensive disease of the breast without a sign of retraction of the nipple. This retraction is caused by the involvement of the ducts and their cicatricial contraction. The dimpling of the skin over the nodule is of greater significance, and is in marked contrast to the protrusion of the growth, in the case of a benign tumor or cyst, above the surface when the patient is in the recumbent posture.

One of the first questions asked a patient with a nodule in the breast usually is: "How long has it existed?" The average period in sixty-eight cases was 10.1 months. It is interesting to note that in sixteen cures the average period was 11.6 months, whereas in thirty-eight failures the average period was 9.4 months.

In private practice the general average was somewhat better, being only 7.8 months. Here again we find eleven successful cases, giving an average of 8 months; and seventeen failures, giving only 7.6 months as the average time. The inference to be drawn from this is, that the longer duration of time during which the disease existed previous to the operation in the successful cases clearly shows a milder form of the disease.

In one case I have succeeded in operating within three weeks from the time the tumor was known *not* to exist. In this case a minute infected gland was found in the axilla. The patient was cured by the operation.

In summing up the results obtained from these data I think we may be justified in saying that a surgical operation can save, as a rule, those cases coming under the head of "scirrhus," and even of "cancer"; that in the case of "medullary cancer" an earlier interference may claim a fair propor-

tion. Before, however, the percentages of success are to be permanently placed so high that we may hope to save over one half of our cases, the professional public must be educated up to that point that they will send their patients early, and not wait until the case has become hopeless before they advise their patient to consult a specialist.

More difficult still will it be to instruct patients themselves to realize the importance of not neglecting any lump in the breast, and also to overcome that strange propensity in the cancerous to conceal their disease.

ARTICLE L.

CORRECTION, BY OPERATION, OF SOME NASAL DEFORMITIES AND DISFIGUREMENTS.

By GEORGE H. MONKS, M.D.
OF BOSTON.

READ JUNE 7, 1898.

CORRECTION, BY OPERATION, OF SOME NASAL DEFORMITIES AND DISFIGUREMENTS.

It is not my intention to take up the time of the Society by reading a long paper which pretends to cover the correction of all possible deformities of the nose by operation. I propose simply to call your attention to a few of the ordinary deformities and disfigurements, and to briefly refer to some cases which illustrate the results obtained by certain operative procedures, some of which procedures are new and some old.

It is hardly necessary, I think, for me to dwell on the desirability of doing such operations. After considerable experience I have become convinced, as probably most of you have, that few patients suffer more of mental discomfort than the unfortunate possessors of some unsightly disfigurement on the face which attracts constant notice, few are more solicitous for any operation which promises relief, and none are more grateful for the slightest improvement in their condition.

The first subject I shall speak of is:

VENOUS AND CAPILLARY CONGESTION ON THE NOSE;

what is known as "Red-nose" or "Toper's Nose."

One meets with all degrees of this form of passive hyperæmia; but the variety which is permanent, and especially that kind which is associated with numerous visible and arborescent vessels, often reaching well back upon the alæ, is usually very annoying to the person affected, especially if he be of a sensitive temperament, and often prevents his

getting employment on account of a supposed alcoholic tendency.

In such cases much can be done in the way of treatment, by destroying the little vessels by *scarification* or *electrolysis;* but in order that the effects shall be permanent the treatment must extend over many sittings and must be conscientiously carried out.

To properly scarify such a nose, it should be first of all thoroughly cleansed with soap and hot water; then firmly squeezed between the thumb and finger of the left hand,

Fig. 1

Thorough scarification of the end of the nose.

and a few minims of a weak cocaine solution injected. When the part is no longer sensitive to pain, multiple incisions should be made in different directions all over the affected area with a small sharp knife. (See Fig. 1.) These cuts need not be very long but should all be deep enough to divide the superficial vessels, whose trunks may often be seen through the skin. If the patient will keep in the house for a few days afterwards, the whole of the reddened area may be thoroughly scarified at the first sitting, after which the surface may be covered with cotton and collodion and the escaping blood allowed to dry and form a crust under it.

If the patient, however, cannot keep quiet for some days, only a few of the largest vessels should be divided at a sitting. In any case the operation will have to be repeated several times, before a satisfactory and permanent result is secured. Though there is reason to believe that the continuity is restored in many of the divided vessels, yet the contraction of the fibrous tissue which forms in all the little incisions will at least prevent the part from returning to its former condition of vascularity.

This congested condition at the tip of the nose can be treated equally well by electrolysis, — indeed, some surgeons prefer it, and claim that by its use less scar results than is the case when scarification is used.

HYPERTROPHIC ACNE

is a condition which is occasionally seen on the nose, and always interests the surgeon, though unfortunately few cases are induced to come to operation.

Some years ago a man with an enormous enlargement of the end and alæ of his nose, due to one form of this condition, came to me, asking for an operation to relieve his deformity. He stated that he was unable to get anything to do in the way of work, as everybody thought him a drinker, which he certainly was not. The whole nose, but especially about the end of it and the alæ, was greatly thickened, nodulated, and reddened, with here and there acne pustules in all stages. All over this area little depressions or pits were to be seen, representing the openings of the sebaceous follicles, and from all of these long worms of sebum could be squeezed out. After thoroughly cleansing the parts, I split the skin and underlying tissue of the nose down the middle line for its entire length, from base to tip, turned back the two flaps to the sides and removed all the subcutaneous tissue I could get hold of. I then replaced the flaps and sewed them together. The alæ which pro-

jected like two small cherries from the sides of the nose were also treated in this same way, and so much underlying tissue was cut away that the nose was considerably diminished in size. Although the result was not so perfect as one might wish, it showed at least a distinct improvement, and the man was apparently perfectly satisfied.

Some time after this operation I described it to one of my colleagues, and showed him the case. He seemed much interested, and was pleased when, some months later, a similar case came under his own charge. He operated upon the man by the procedure which I had employed. Imagine his disgust, however, when, soon after the operation, the flaps sloughed! I fancy he had been more radical in his operation than I should have dared to be, and did not leave enough tissue for his pedicles. In time, however, the dead flaps separated, and left the nose without any cutaneous covering, the raw surface granulated, and finally cicatrized; and the man was ultimately glad to possess a small, thin, white nose (even if it was nothing but the framework of a nose, covered with one enormous scar), in place of the large, reddish, nodulated organ which he formerly had, and he (who, by the way, thought that the sloughing process had been intended as a part of the operation), pronounced the result a complete success! Referring to the result of his operation, my colleague suggested that the best treatment for these cases was probably, after all, simply to pare them down with the knife to the desired size and shape, and leave the raw surface to granulate. I should seriously consider doing this very thing if another of these extreme cases should come to me, only I should certainly prefer to cover the raw surface with skin grafts rather than to leave it to granulate.

BIFID NOSE.

This is a congenital condition, though a rare one. It would appear in these cases that during the develop-

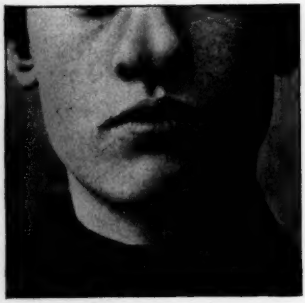

Fig. 2.

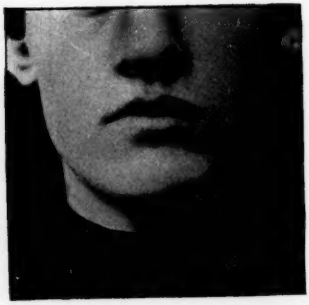

Fig. 3.

Fig. 4.

Fig. 5.

mental period of life the two halves of the nose fail to approach sufficiently near each other in front, and for this reason a long vertical depression remains in the middle line. This depression is permanent, and causes a very noticeable deformity. It of course belongs to that large group of malformations known as "defects in the median line of the body."

Some years ago I operated upon such a case. The patient, who was sent to me by Dr. Gilbert N. Jones, then of Gloucester, was a young girl of fourteen years (see Fig. 2), who had always been particularly sensitive about the deformity; her acquaintances having done their best that she should not forget it. I removed an elliptical piece of skin and underlying tissue from the depression, brought the two sides together, and united them with buried and superficial stitches. The result was very satisfactory, for instead of the peculiar double-pointed nose (see Fig. 4), which attracted so much attention wherever she went, she now had a nose that was normal in appearance, except for a slight scar in the median line. (See Figs. 3 and 5.)

DEFORMITIES DUE TO OLD INJURY.

We frequently meet with noses deformed by injury in which the displacement occurring at the time of the accident has been allowed to remain unreduced. The appearance of such injured noses naturally varies; they may be bent, twisted or depressed, or there may have been loss of substance. Probably the commonest form is that in which there is a certain deviation of the bridge to one side or the other. The upper or bony part of the bridge may deviate, or it may be straight while the lower or cartilaginous part may be deviated, or the entire nose may be pushed to one side or the other. Such conditions may be congenital, but they are far more frequently due to some blow or fall. While in certain cases the nasal bones are undoubtedly fractured,

and perhaps also the septum, I think it probable, judging from many of the cases I have seen, that the cartilaginous part of the nose is quite frequently torn away from the nasal bones, for in many cases where the nose has been injured we later see a bunch, indicating probably a new bone formation, on one side of the nose at a point exactly where the bony and cartilaginous parts should join.

I have operated upon one such case by chiselling off the little bony hump through a small incision in the skin at one side of it. The patient expressed himself as pleased with the result. Although the procedure was satisfactory in this special case, I felt that it would not do in all cases, for one meets with many of them where the bony projections on the bridge are so large that they cannot be cut away without making very large incisions, and also running the risk of opening into the nose and thus leaving a permanent hole through the bone.

In seeking to discover some means of fracturing the bony bridge of a nose without bruising or cutting the skin, I devised a method which has worked very well indeed. After the patient is under an anæsthetic a small incision is made just beneath the tip of the nose, its axis being continuous with that of the columna. Through this incision the points

Fig. 6

Showing the incision just below the tip of the nose — being the opening of the tunnel leading upward to the area between the skin and the framework of the bridge of the nose.

of a small pair of blunt pointed scissors are inserted. It is now found that by opening and closing the scissors laterally so far as the limited size of the incision will allow and pushing them upwards the points of the scissors can be made to travel in that direction, and a narrow pathway or, more properly speaking, a long flat tunnel is cut in the tissue between the skin and the bridge of the nose. This subcutaneous tunnel is continued well up to, and upon, the bony bridge (see Fig. 7). The projecting bony parts are then

Fig. 7

Showing the method by which the subcutaneous tunnel is made with the scissors.

depressed, to any desired degree and extent, by a process to which I should like to call your special attention; for by its means the bony bridge of the nose can be fractured without leaving in the skin over the bridge any sign of injury except two or three minute punctures. Two little instruments (A and B, Fig. 8), besides a mallet, are necessary

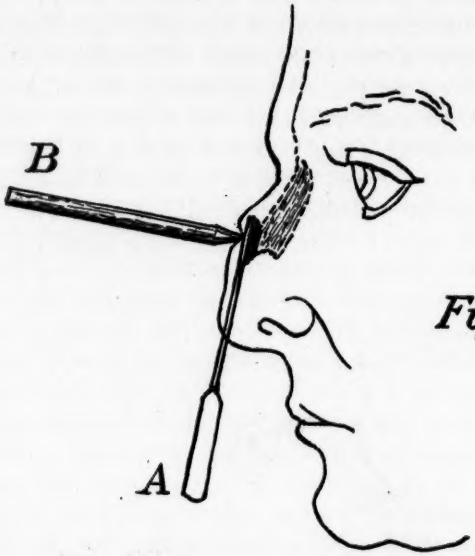

Fig. 8

Instrument A has been inserted into the subcutaneous tunnel until its roughened extremity rests upon the projecting bone. The point of Instrument B, having punctured the skin, is made to rest in the little depression on the back of Instrument A.

for this operation, each instrument being about two or three inches long. Instrument A has a flattened extremity at one end and a handle at the other. On one side of the flattened extremity the surface is roughened like a coarse file, and on the other side is a minute depression which receives the point of instrument B. Instrument B closely resembles a very sharp pointed lead pencil.

Instrument A is inserted into the incision, just below the point of the nose, and is then pushed upwards along the subcutaneous tunnel already spoken of, until its roughened end is made to rest over the projecting part of the bony bridge which it is desired to fracture (as in Fig. 8). The point of the instrument B is then gently inserted through

the skin into the little hole already referred to on the back of the flattened extremity of the instrument A. The two instruments being then in the position shown in Fig. 8 are rigidly held, a few taps of the mallet on the end of the instrument B being sufficient to cause the fracture and depression desired at any point in the bony bridge. It may, in certain cases, be necessary to fracture the bone over a larger area. This of course can be easily accomplished by the same method.

After the operation has been completed there remain on the bridge of the nose where the bone has been fractured only a few minute punctures, which eventually cicatrize and are not noticed. This method of fracturing the bony bridge of the nose is of course only applicable to cases where there is undue prominence confined to a limited area on the bridge, and is not to be used in cases where there is deviation to one side or the other of the entire bony framework of the nose.

The method of tunnelling under the skin by means of scissors is one which I devised some years ago for other purposes than that mentioned here, and which I have found most useful in many cases.

SADDLE-BACK NOSE.

Another kind of deformed nose is what is called "Depressed or Saddle-Back Nose." This may be due to injury or disease, and the operation selected for its relief naturally varies with the cause or the special deformity in each case.

One case of this kind, already reported at length,* and simply referred to here, was a young girl of sixteen, who as a result of inherited disease, had a saddle-back nose of such an extreme degree that the bridge of the nose was sunken to nearly the level of the cheeks, and was covered with a dense scar. The end of the nose was tipped up and

* See Boston Medical and Surgical Journal, June 25, 1896.

the nostrils looked forwards. On account of her deformity she could get no employment. In this case, for certain reasons too many to be mentioned here, I thought it best to dissect off the scar over the depressed bridge, and, after freeing the tip and nostrils by a horizontal cut directly backwards through the lower part of the nose, I depressed them downwards into place, and then covered the gaping wound and the raw surface left by the removal of the scar with a flap from the left forearm. The result was satisfactory; the flap grew in place and covered both raw surface and gap. The tip of the nose faced forwards instead of upwards, and the nostrils faced downwards instead of forwards.

In another case, a young woman of twenty, with depressed nose from inherited disease, I inserted a platinum plate, which lifted up the bridge and gave perfect satisfaction until, one day, many months after the operation, she was in sport peeping through a key-hole, when another girl gave her head a push, driving it against the door so violently that the end of the plate came out. This was of course followed by suppuration which necessitated the removal of the plate. In spite of this, however, the collapse of the nose was apparently not so marked as before the operation, and the patient declared that she thought the nose was firmer and that there was more bone in the bridge than before the plate was inserted. I did another operation on this nose, trimming a little here and there, and finally inserting a small bit of bone (from which the animal matter had been removed), which bone seemed to elevate the bridge somewhat, and which to this day,—the operation was done three or four months ago,—has given no trouble.

A young woman of twenty was referred to me some time ago by Dr. Mahoney of Medford. Two years previously she had a fall upon the ice, which had apparently caused a permanent depression of the cartilaginous bridge of the

Fig. 9.

Fig. 11.

nose, giving rise to a very unsightly depression in the lower part of the bridge, and a corresponding elevation of the tip of the nose. (See Fig. 9.) A celluloid piece (A, Fig.

Showing where the piece of celluloid should rest in order to restore the lower part of the bridge.

10) was inserted through an incision below the tip, which raised the bridge of the nose, so that the line of the entire bridge was nearly a straight one, and the patient was very well satisfied. The appearance of the nose after operation is well shown in Fig. 11.

The photographs from which Figs. 9 and 11 were taken are now in my possession.

In another case, a young lady, referred to me by Dr. E. H. Bradford, where there was a depression of the entire bridge, but especially of its upper part, I inserted a piece of celluloid high up on the bridge under the skin, having extended my subcutaneous tunnel higher upwards for that purpose. The operation was done several months ago, and the result has been an entirely satisfactory one. Not only is the depression, as seen in profile, far less marked than

formerly, but the patient writes me that since the operation she can breathe more freely through the nostrils than ever before.

DEPRESSION OF LOWER HALF OF NOSE.

Occasionally one meets with cases where both the cartilaginous bridge and also the tip of the nose are collapsed. In such cases operative procedures are of no great avail; for, unless some pretty extensive artificial framework is inserted under the skin there is nothing to support the parts. In one case of this kind where the tip of the nose and the cartilaginous bridge were greatly depressed as a result of disease, and the columna of the nose (*i. e.* the narrow isthmus in the median line which connects the base of the nose with the tip) was wanting, I was able to supply a new columna from the skin of the arm, thus giving the man a somewhat more sightly organ, but I could not raise the tip, and keep it in position.

The plan has been advocated, and put into operation in a few cases, of inserting a large artificial framework to overcome a collapsed condition of the nose. Judging from the reported cases I have seen, the good results have not been sufficiently lasting to lead us to hope much from the operation, for the apparatus, which it must be extremely difficult to cover up completely in the tissues, probably acts as a constant irritant, causing chronic suppuration and necrosis, necessitating its ultimate removal.

In conclusion I would say that, while many cases of deformed nose are so extreme that nothing can be done for them in the way of operation, there are many others in which a distinct *improvement* may be brought about, which, though not always entirely satisfactory to the surgeon, is almost invariably appreciated by the grateful patient.

ARTICLE LI.

FORMALDEHYDE GAS AS A DISINFECTANT.

By DAVID D. BROUGH, M.D.
OF BOSTON.

READ JUNE 8, 1898.

FORMALDEHYDE GAS AS A DISINFECTANT.

SINCE the discovery of the germicidal powers of formaldehyde gas this agent has been the subject of rigorous investigation by a large number of observers, both in this country and abroad. The most improved methods of scientific investigation have been applied to it. Many things are now known concerning the gas that are absolutely certain, while many of the extravagant claims that were first promulgated have been proved to be based on insufficient evidence. There are some questions that have not yet been satisfactorily answered, and more experience with the use of the gas will further enlighten us. In general, there has been a harmony in the results of all observers while there may be a wide divergence in some of the minor points.

It is simply my desire to present, as far as I am able, the value and limitations of this agent in practical disinfection, that have been drawn from practical experience during the year and one half in which formaldehyde has been used by the Board of Health of the City of Boston. I think that the Board of Health of this city has been among the first, if not the first, to introduce this gas in the routine work of municipal disinfection.

All the experiments that I have conducted have been carried on in the various dwellings of the city which have required disinfection on account of having contained some case of infectious disease. All the tests were made under condi-

tions as they actually occur. Having been made in the various houses, the results may differ in some respects from those performed in laboratories or especially constructed chambers.

The gas was discovered by Van Hoffman in 1868. He found that the vapor of wood alcohol coming in contact with finely divided platinum, gave rise to a product to which the name of formaldehyde was given. It is a product of the oxidation of methyl or wood alcohol. The oxidation results in the removal of the hydrogen from the alcoholic vapor forming formaldehyde. Its chemical formula is CH_2O. The gas can be prepared by bringing the vapor of wood alcohol properly mixed with air into contact with a metallic powder heated to dull redness. The contact of the alcoholic vapor with the metal continues to keep the metal heated. The substances most used are platinum, copper, iron-oxides and coke. The most active substance is spongy platinum or platinum black.

The gas is colorless, has a penetrating pungent odor, and is extremely irritating to the mucous membrane of the eyes, nose and throat. Its specific gravity is about the same as air. It renders gelatine insoluble and coagulates albumen when in the solid form. When added to a solution of serum albumen it prevents coagulation by heat. Pieces of meat exposed to the gas have been preserved for a long period of time.

The odor of formaldehyde is easily dissipated by the evaporation of ammonia. After disinfection the odor of formaldehyde can be neutralized by injecting a little ammonia into the room. By cooling, the gas can be mixed with water up to the proportion of 40% by weight of the gas. It is in this saturated aqueous solution that the gas appears in commerce under the name of formalin.

When the aqueous solution is allowed to evaporate in the air it becomes concentrated, forming a substance known as

para-formaldehyde, which is a union of two molecules of formaldehyde gas, and when further concentration goes on a white amorphous powder, known as trioxymethylene, is formed. This latter form is supposed to be composed of the union of three molecules of the gas. From both these polymerized forms the gas can be derived by the application of heat. The antiseptic and germicidal powers were, it is said, first noted by Trllat of Paris in 1888, and in 1891 an account of these properties was published by him.

The disinfection of rooms is performed by formaldehyde in the gaseous state. This gas can be obtained in several ways:

1. By means of lamps directly from wood alcohol.
2. From the solid form.
3. From the solutions of formaldehyde.

But from whatever form the formaldehyde is obtained, the results are derived from the gas that is generated. The various preparations in which formaldehyde appears, and the different kinds of apparatus, are but convenient methods of utilizing the gas.

DIRECT GENERATION OF THE GAS.

Probably one of the first lamps in this country for the generation of the gas on a scale sufficient for general disinfection, was devised by Prof. Robinson of Bowdoin College. There are many modifications of this idea on the market.

In general, the principle is to bring the vapor of wood alcohol properly mixed with air in contact with platinized asbestos which is thoroughly heated. This method has been tried in this city and in others but has now been generally discarded. The objections to this process were the dangers of fire, the difficulty of knowing whether the apparatus was working properly when shut up in a room, and the difficulty of bringing the vapor of the wood alcohol directly in contact with the platinized asbestos disk. After being used for

some weeks in this city it was given up. While good results have been obtained from experiments with this method, it was found impracticable for municipal disinfection.

With the generation of the gas from the combustion of paraform pastilles, I have had no personal experience. The excessive cost of this method would be almost prohibitory for its use on the scale demanded by municipal disinfection. In the hands of those who have used it, excellent results have been obtained. The conclusions were about the same as have been obtained by deriving the gas from the aqueous solutions. It is, however, a neat and simple method of obtaining the gas.

The gas can be obtained readily from the 40 per cent. aqueous solution. Disinfection in small closed spaces can be accomplished by allowing the solution to evaporate in open vessels or pans, but only a small portion of the total gas is given off. This is due to the fact that polymerization occurs and the solution becomes concentrated into the solid form and little gas is given off. In larger rooms this method would be wasteful and unsatisfactory. In laboratory tests fair results have been obtained.

Dr. Kinyoun of the Marine Hospital Service could not obtain satisfactory results in disinfecting rooms by saturating clothes with formalin and allowing the solution to evaporate in the room. In some late experiments by the Chicago Board of Health it is claimed that sheets, wet with the solution, suspended in the room and allowed to dry, gave as good results as other methods. The inconvenience of this process in dwelling-house disinfection has prevented any tests being made in this way. Nor can disinfection be accomplished by mixing formalin and water and simply heating the mixture in a closed vessel not under pressure. In the tests of Dr. Harrington of Boston at the City Hospital, the results were unsatisfactory and no disinfection was accomplished. A large amount of the formalin

became polymerized at the bottom of the vessel. It is necessary, therefore, owing to the fact that polymerization occurs, that some form of "regenerator" should be used of which there are a number on the market. We have used two forms. In one the aqueous solution is heated in a closed cylinder until a pressure of three atmospheres is attained and then the gas is allowed to flow through a tube and pipe, which is passed through the keyhole of the door of the room to be disinfected. In the other form the solution passes from the cylinder into a copper tube which is coiled over a lamp, and then becoming superheated the gas passes through the tube and pipe through the keyhole of the door. The first form has been preferred, as it discharges a very much larger amount of gas in the same period of time, and is not so liable to get out of order. The second form, however, obviates any danger of explosion which may possibly occur in the first method. It has never been found that with care, there was any danger of explosion. These machines are kept outside of the rooms and their working can be observed by the operator. We have found no benefit whatever to result from mixing the formalin with calcium chloride over that of the simple 40% aqueous solution. Other observers agree in this. It must be recollected that the disinfection is accomplished by the gas, and not by the apparatus as some manufacturers would have us believe. That form of apparatus is best which will conveniently deliver the largest amount of gas in the shortest period of time. Through the courtesy of Dr. Ernst I was enabled to perform this bacteriological work in the laboratory of the Harvard Medical School.

The tests were made of silk threads and gauze strips which were saturated with bacilli from twenty-four to forty-eight hours' bouillon cultures. Most of them were placed in the rooms in the dried condition, as it was desired to make the tests correspond as nearly as possible with the con-

ditions under which we would find the organisms in infected houses. Wet cultures were also used in many of the experiments. All the ordinary pathogenic organisms were used, but the diphtheria bacillus of a high toxine-producing power, and from fresh throat cultures, was regularly employed, as this is the known organism for which disinfection is carried on. Some tests were made with a non-pathogenic spore-bearing organism, and cultures were made from the dust of the rooms before and after disinfection. Freshly inoculated serum tubes of the various organisms were placed in the rooms, both open and plugged. Control cultures were made in every case, and in these growth was obtained in twenty-four hours.

The conclusions were drawn from the seventy-two hours' result in the incubator. The threads were placed in the nutrient media in the rooms directly after the disinfection with sterilized forceps.

Bouillon and Loeffler blood serum mixture, in tubes, were the media employed. The bouillon shows whether the disinfection was complete. On blood serum the amount of disinfection and the inhibitory effect of the gas could be more approximately judged by the number of colonies; microscopic examination was made in every case to determine the nature of the growths.

The general results were obtained from 36 houses, in each of which from 6 to 20 tests were made. The dwellings in which the tests were made were scattered throughout the city. The houses were of every description and variety, although most were among the poorer classes. The conditions were not favorable for obtaining the very best results, and the conclusions must certainly give a more approximate idea of the value of the gas than those carried on in absolutely tight rooms or under more favorable conditions. Nothing was removed from any of the rooms. The furniture, upholstery, bedding, wearing apparel and all other articles were

left in their places. Beyond spreading out the clothes and bedding, opening doors of cupboards and closets, opening drawers so that all surfaces might be exposed as much as possible to the gas, nothing was done in the way of preparation.

The crevices about the windows, cracks of doors, fissures in walls, loose flues and other places through which the gas could escape, were closed by pasting them with narrow strips of gummed paper. This is made for the Board of Health in rolls of about one inch wide. After closing the door and pasting the cracks, the gas was introduced through the keyhole.

The gas enters into the room in practically a dry condition. In repeated experiments no special difference could be noticed in the amount of moisture in the rooms before and after the introduction of the gas, as noted by the readings of the wet and dry bulb thermometers.

CONCLUSION FOR SURFACE DISINFECTION.

Whenever the gas in sufficient amount comes in contact with pathogenic organisms, they are invariably killed.

Spore-bearing organisms are killed with more difficulty than those that are not spore-bearing, and the results with non-pathogenic are not so constant as with pathogenic organisms. The position in the room makes no difference. Those placed close to the ceiling, those on the floor, and those at points midway between these, were equally sterilized. Threads stretched from the ceiling to the floor were completely sterilized. Currents of air near the test objects interfere with the action of the gas. In the experiments of Robinson and Bryant of Bowdoin College, and Dr. E. M. Parks of New York, threads that were placed on window sills or near cracks of doors were frequently found not to be sterilized.

The gas apparently acts equally well on both wet and dry cultures. This was my experience with silk threads

and squares of gauze. The same results were found by Parks and Robinson and Bryant. Dr. Harrington of Boston, in his experiments at the City Hospital, found that organisms on dry surgical dressings were completely killed, while with wet dressings only those on the surface were destroyed. Organisms growing in bouillon exposed in Petri dishes could not be killed.

The dust of the room was sometimes sterilized, sometimes not. A spore-bearing bacillus was frequently found not acted upon by the gas. The number of colonies in a measured quantity of dust was invariably found much larger before than after the disinfection. Generally after exposure only a few colonies were found.

Dr. McCollom, of Boston, in his experiments found that the gas acted as well on the discharges from nasal diphtheria and diphtheritic membrane as on cultures grown on artificial media, when they were directly exposed to the action of the gas.

PENETRATION.

In ordinary disinfection these tests would prove that the gas has very little penetrating power. It was the invariable result that cultures, whether wet or dry, when placed between mattresses, between pillows, between the folds of mattresses, in the centre of pillows, between the leaves of books and between solid objects, were not killed. When the organisms were wrapped up firmly in layers of blankets or heavy articles they were not rendered sterile; placed in pockets of coats and trowsers, dresses, or wrapped up with light articles as sheets, handkerchiefs, etc., the organisms were sometimes killed and sometimes not. When placed in drawers left open slightly, they were killed; when the drawers were closed they were sometimes killed and sometimes not. When the threads were placed in the bottom of test tubes, and these tubes were left open in the vertical

position and exposed to the gas, growth was frequently found. When these same tubes were placed in the horizontal position, and the threads placed near the mouth, the organisms were killed. Freshly inoculated serum tubes, with the cotton plugs in, would always yield a growth. The same tubes with plugs out only gave slight growth at the lower portion of the serum slant. The opinion of all recent observers is that the gas is a poor penetrating agent under ordinary conditions. This is the conclusion of Dr. Doty of New York, Robinson and Bryant, Dr. Wilson of Brooklyn, Dr. E. M. Parks of New York, Drs. Harrington and McCollom of Boston, and others.

In experiments with absolutely air tight receptacles and bags and in the use of the gas by the vacuum method, with which I have had no personal experience, the penetrative power of the gas was found much greater.

Dr. Doty of New York has found that penetration is much increased with a vacuum. Dr. Wilson of Brooklyn was able *in vacuo* to kill organisms, even anthrax spores, in mattresses or wrapped in heavy blankets. Dr. Wyatt Johnson of Montreal has been able to secure complete sterilization *in vacuo* of objects in tightly rolled blankets. Robinson and Bryant, of Bowdoin, found with an excess of gas in air-tight bags, penetration could be secured through rather bulky articles. Other observers found similar results. Dr. Harrington says that "In presence of moisture the penetrating power is practically *nil*."

For penetration under ordinary conditions the gas has no especial value.

EXPOSURE.

In my own tests I have found no difference in results from exposures of 5, 6, 7 hours and upwards. As good results were obtained in the shorter period of time as in the longer. If the results with a certain amount of gas were

not satisfactory with a short exposure they never were with a longer. It would seem that the work of the gas was accomplished quickly.

Dr. Doty thinks an exposure of six hours is sufficient.

Dr. E. H. Wilson says: "It is preferable to allow the gas to remain as long as possible, but from three to four hours is sufficient for good disinfection." In surface disinfection he was able to kill the ordinary pathogenic organisms in four hours.

Dr. Parks, of New York, says: "The time of exposure not to be less than two hours, better to give four to six hours."

Dr. Harrington has found that "the organisms will be killed in from one half to three hours, varying with the amount of the gas used." Bryant and Robinson state that "the room should be closed from ten to twelve hours."

Dr. J. J. Kinyoun says: "The length of exposure is secondary to the amount of the gas, and a larger amount will give better results than small, even prolonging the length." He further states that fully twelve hours' exposure should be given. I think that most later observers in the main agree that as good results are accomplished in short exposure as in long.

INFLUENCE OF TEMPERATURE.

Within the range of temperature, such as occurs in ordinary disinfection, the gas seems to act perfectly well. With a low temperature, below 35° F., my results were not so satisfactory, even using large amounts, as with a higher temperature. It would seem that very low temperatures interfere with the action of the gas. Other observers have found that the gas is more active at a fairly high temperature. In general, the majority of observers have found equally good results between 50° and 110° F.

What is the amount of formalin necessary to generate gas sufficient to disinfect 1,000 cubic feet in ordinary rooms?

On this question there is a very great variance amongst different observers, even when using the same form of regenerator. Some have obtained complete results with very small amounts, while others using small amounts have claimed that formaldehyde was useless for disinfection. Most of the poor results seem to have been obtained from using too small amounts of the gas. With nearly air-tight rooms, or rooms where there is little absorbent material, we can get much better results with small amounts. In ordinary dwellings, where there is always considerable leakage, and where there is a great amount of bedding, upholstery, clothing and plastering which must necessarily absorb a large amount of the gas, very much larger quantities have been found necessary. Generally with small amounts of from 4 to 12 ounces to 1,000 cubic feet, I could not get very good results; occasionally they would be good. But on increasing the amount the results were much better. To get satisfactory results in house disinfection, I agree with Dr. Wyatt Johnson of Montreal that at the very least one pound of formalin to 1,000 cubic feet should be used, and it would be better to use even considerably more. In this city it is the custom to use nearly a quart to the 1,000 cubic feet, and the varying and inconstant results with small amounts have not been repeated.

INFLUENCE ON HOUSEHOLD GOODS.

In our experience in this city there has never been any injurious influence exerted by the gas upon any article of household furniture, clothing, bedding, upholstery, carpets, or on any ornaments, pictures, gilding, or on wall papers. Further, no person has complained of the gas causing any injury to his goods, and this after the use of formaldehyde in many hundreds of houses in all grades of society.

Dr. Kinyoun, in his experiments with 225 samples of wool, cotton, textile fabrics, hair, fur and leather, found

them unchanged by the gas. Colors are not affected with the exception of the aniline color fuchsine which is changed to purple; all other observers practically agree in these results.

INFLUENCE ON ANIMAL LIFE.

Our opportunities for observation in this line have been limited. Dogs and cats which have been left in rooms were found killed. Flies were invariably found dead. Bed bugs, which were exposed to the direct action of the gas, were likewise killed.

Drs. Harrington and McCollom both found that the gas was fatal to rabbits. The early claims of the innocuousness of the gas to all animal life have not been substantiated.

IN CONCLUSION.

I believe we have in formaldehyde the best practical gaseous surface disinfectant known. For dwelling-house disinfection it is unsurpassed. It is easy of application, and does no injury to goods. It is not ideal, its use being limited to surface disinfection. Its penetrative powers under ordinary conditions are so slight as to be almost valueless. Good results are best obtained by using a large body of gas, and having the room as tightly sealed as possible. Length of exposure and the influence of temperature are secondary to the amount used.

Under these conditions disinfection may be regarded as complete after the use of formaldehyde.

ARTICLE LII.

AN OUTLINE OF THE CLINICAL USES OF THE FLUOROSCOPE.

By FRANCIS H. WILLIAMS, M.D.
OF BOSTON.

READ JUNE 8, 1898.

AN OUTLINE OF THE CLINICAL USES OF THE FLUOROSCOPE.

THE subject of X-ray examinations in medical practice has developed to such an extent that it cannot be fully presented in a short paper. Two courses lie open; either to take up a single disease and discuss it in detail, or to go over a number of diseases briefly. It has seemed to me that the latter would be the more acceptable course. I shall, therefore, present the results of the clinical observation made in some of the patients I have examined in order to suggest ways in which an X-ray examination may corroborate other evidence or assist us to an earlier or to a more correct diagnosis.*

In a general way X-ray examinations may be said to have thus far been most used to detect foreign bodies, or changes in shape and composition of bones as in fractures, dislocations, necrosis, tuberculosis, rickets and osteomalacia.

Gouty deposits about the joints as shown by Dr. Arthur L. Fisk are distinguished from rheumatoid arthritis by means of an X-ray photograph.

* I have found the following a convenient method of making X-ray examinations with an open fluorescent screen:

The room should be dark, and even the light which comes from the Crookes tube must be excluded; this can be done by wrapping the tube in black velvet. Any other source of light, as the spark gap, should also be excluded. The fluorescent screen covered with a sheet of thin, perfectly clean glass, or a water-proof film, is then put on the patient's chest. With a lithographer's pencil (if the surface of the film is ground an ordinary pencil may be used) the outlines of the heart, for example, may be traced on the glass and when a record is desired they may be copied by tracing them on paper in the daylight. After cleaning the glass with alcohol, or the film with water, it may be used again. Whether the patient is examined sitting up or lying down, the tube should be more than two feet from him, and when examining the thorax, opposite the midsternum on a level with the nipple.

The stomach may be examined by giving the patient a large dose of subnitrate of bismuth (which the X-rays do not easily traverse) with food and then looking at the shadow of its contents by means of the fluoroscope. I have also taken in this way an X-ray photograph of the stomach contents.

Renal calculi containing phosphate or oxalate of calcium of fair size have been detected by an X-ray photograph.

But one of the most useful medical applications is for diseases in or contiguous to the thoracic cavity. I shall consider this subject largely from the standpoint of a practitioner whose special interest is diseases of the chest, for it was the confidence which I had in the possibilities of the fluoroscope to assist in the diagnosis of diseases of the lungs and heart that led me to begin and develop this method of examination.

I think the story can best be told by the following cuts, Figs. 1 to 12, which are reduced copies of diagrams made by transferring outlines that I drew on the skin of patients while looking through the fluoroscope, to a skeleton outline copied from one of Luscka's plates. These patients were examined lying down, except the one suffering from pneumo-hydrothorax.

Since it is in part the *movement* of the heart and lungs which we wish to observe, an X-ray photograph does not answer as well as the fluoroscope or fluorescent screen. Examinations with this instrument have also the advantage of being made more quickly, the photograph takes time to develop.

The position of the diaphragm and heart are shown as in full inspiration in the diagrams, Figs. 1 to 12, and the broken lines indicate the position in expiration. The dark lines at the sides represent the level of the nipples.

In Health (Fig. 1) you will see that the diaphragm has a wide excursion between the extremes of respiration and

that the heart also changes its place. In order that you may appreciate what nice distinctions the fluoroscope is capable of making, let me state that the difference in the brightness of the lung area between expiration and full inspiration may be perceived in the fluoroscope. In health the lungs are seen to be lighter about full inspiration and darker in expiration, as they then contain more blood. This shows how conditions involving congestion as in early tuberculosis or in some forms of cardiac disease may alter the appearances in the fluoroscope.

The diagram of health (Fig. 1) is the key to the others and I shall ask you to use it as a starting point in studying them. Please compare individually the diagram of each of the diseases as I take them up with the diagram of health, especially the amplitude of the excursion of the diaphragm and its position in the thorax in certain of them.

We will begin with *thoracic aneurism*.

Many thoracic aneurisms (Fig. 2) which were formerly beyond our reach for diagnosis may now be recognized with certainty, and further, symptoms due to aneurism are sometimes ascribed to other diseases and an X-ray examination is required to establish the diagnosis. This diagram represents the condition found in a patient sent to me in consultation who had a stricture of the œsophagus, and into whose throat an œsophageal bougie had been passed every third day for months. Another patient, who had a similar aneurism, was thought to have intercostal neuralgia and had been operated on for this previous to coming to me. In one of my own patients with cardiac disease I was about to give digitalis, but an X-ray examination showed the presence of a thoracic aneurism in an early stage, and I was thus spared from doing him harm. In no other way than by an X-ray examination could these aneurisms have been detected in this early stage.

In emphysema (Fig. 3) you will observe that the excursion of the diaphragm is less than in health and that it is

lower in the chest. The heart is in a more vertical position than in health and moves less between full inspiration and expiration. In marked cases the right side of the heart, both auricle and ventricle, is larger than normal.

In pleurisy with large effusion (Fig. 4) the heart is much displaced as indicated by the diagram. I removed a gallon of fluid from this patient's chest.

In pleurisy with slight effusion (Fig. 5) the appearances in another patient are shown. By auscultation and percussion there was some doubt about the presence of fluid in this patient's chest.

In *pneumonia* (Fig. 6) the dark area of the pneumonic process is seen and further the excursion of the diaphragm is less than normal. The appearances in pneumonia are very conspicuous, so much so that I have not chosen a patient in the most active stage of the disease, but rather during its subsidence. This diagram was made from the appearances on the seventeenth day of the disease. No signs were found by auscultation and percussion on this day. This shows that there may be conditions in the chest which are readily seen in the fluoroscope but which are not patent to auscultation and percussion. On the thirty-second day there were still signs of disease by the fluoroscope, but the patient was then discharged, otherwise an abnormal condition of the lungs might have been followed by means of this instrument for some time longer.

Pulmonary tuberculosis.—It seems hardly necessary to state that the diagnosis of pulmonary tuberculosis is not made by an X-ray examination alone, but the fluoroscope may show that the lung is in an abnormal condition in two ways; the diseased portion appears darker than in health, and the excursion of the diaphragm in quiet breathing and in full inspiration is restricted. These signs lead us to suspect tuberculosis. I have taken every opportunity to examine patients with tuberculosis in the early stage and have

sometimes found evidences of disease more marked in the fluoroscope than by auscultation and percussion. (When the disease has made progress the appearances in the fluoroscope are, of course, very conspicuous.) In the patient from whom the *diagram of tuberculosis* (Fig. 7) was made, the signs by auscultation and percussion were so indefinite that the site of the disease was not located. The excursion of the diaphragm as here represented is more restricted than usual in an early stage of this disease.

Further, I have found suggestion of tuberculosis in some patients whose lungs by auscultation and percussion at that time had been found normal, and whom I examined with the fluoroscope with reference to some other disease. This diagnosis was confirmed by the subsequent development of the case, the presence of bacilli, or by reaction to the tuberculin test.

The dark areas which are found in the lungs in pulmonary tuberculosis are not wholly due, I think, to a consolidation, for a marked congestion may give rise to similar appearances. In some patients, whom I have examined at intervals of a week or two, I have seen these dark areas extend rapidly, and in others diminish in the same way, and as it does not seem probable that changes in the lung tissue would take place so quickly as the increase and decrease of these dark areas would suggest, a congestion seems to be the natural interpretation of this rapid alteration in the brightness of the lung. Further, in passive congestion of the lungs in mitral disease the lower portions of these organs may be darker than normal without corresponding physical signs; and after rest, and the administration of digitalis, the lungs soon become clear. Also in patients apparently suffering from debility, and who do not react to tuberculin, we may find a dark area in the lung that clears up after a rest of a week or two. The recognition of a congestion, especially at the apex, may be valuable in

some cases, as an early warning of the beginning of tuberculosis, and it should certainly cause us to make a careful investigation with this diagnosis in mind.

As the X-ray examinations in pulmonary tuberculosis come more into use I am convinced we shall sometimes recognize its presence earlier, and be less apt to overlook the disease in its beginning. (See cases p. 868.)

In *pneumohydrothorax* (Fig. 8) when the patient is sitting up, the appearances are as shown in the diagram. The fluid is on the left side, and the heart is displaced to the right. The level of the fluid changes as the patient bends backwards or forwards. When he is gently shaken the splashing of the fluid is clearly seen, and while quiet the waves made by the heart beat are very visible. Last summer I demonstrated this to Dr. Buckingham, who, were he not detained by his duties as treasurer, would tell you that he related what he had seen to other medical men, who could not be induced to believe it was not a joke.

In *pneumothorax* (Fig. 9) the diaphragm on the affected side is much depressed, and it has little or no movement during respiration; the heart is pushed to the other side. This patient also had tuberculosis on the right side.

Let us now take up a little more in detail X-ray examination in diseases of the heart, and recall that the heart is a very moveable organ; that its size varies under different conditions; that it is readily pushed out of place, and even in healthy individuals the direction of its long axis is not the same; in some persons the axis is more inclined, in others more vertical.

The outline in Fig. 10 shows what is seen in the fluoroscope when placed on the front of the chest. The heart is seen to change its position during deep inspiration, being moved downwards and inwards. By looking through the body from *side to side* (no diagram of this is shown) the lower and posterior border of the ventricles may be seen

when the diaphragm is depressed by a full inspiration, and there are individuals in whom nearly all of the anterior and of the posterior borders of the heart can be followed in the fluoroscope.

The position of the heart is seen to be changed in diseases affecting the lungs, pleura or blood vessels, or by conditions in the abdominal cavity, pressing the diaphragm up.

A lessened movement of the heart in deep inspiration may be seen to occur in emphysema, or where the pleura or pericardium is adherent. In one patient I saw the apex tilted up during deep inspiration instead of moving down. This was due, I suppose, to adhesions. We may thus follow some of the effects on the heart of changed conditions in its vicinity. A diminished or an abnormal movement of the heart during a deep inspiration may be evidence of adhesions.

Let us consider now some of the changes which affect more nearly the heart itself:

Warning may be given by a passive congestion or œdema of the lungs of a serious condition of the heart or kidneys. Fig. 12 represents this condition, though it may be more marked than is shown in this diagram. The lower portions of the lungs are dark, the outlines of the diaphragm cannot be seen, and only a portion of those of the heart. By such appearances as these I was led to warn one of my patients who had renal disease to put his affairs in order; he died suddenly within three months. By auscultation and percussion I had not appreciated the serious condition of his lungs.

In *pericardial effusion* the outlines of the heart may be obliterated, and instead of the usual pulsating heart we see a much larger dark area. The size, shape and position of the pericardial effusion, and the fact that the outline of the pulsating heart cannot be seen, assists in making the diagnosis. New growths about the heart may sometimes be seen.

An enlarged heart, as in arterio-sclerosis, may be recognized in the fluoroscope, and also a heart smaller than normal, with which anæmia is sometimes associated, may be readily seen in the fluoroscope. It is, I believe, important for the physician to be aware of the existence of a small heart in any of his patients.

A transposed heart (no diagram of this is shown) may easily be seen in the fluoroscope. During my recent service at the Boston City Hospital my house physician asked me to explain to him the conditions present in the heart of a patient who had been admitted the day before. I examined the patient but withheld my opinion until I had made an X-ray examination, as the heart sounds and murmurs were unlike any I had ever heard in that place. On examination with the fluoroscope I found that the patient's heart was transposed, the left ventricle could be seen beating to the right of the sternum, and the right auricle was on the left of the sternum. When the patient was turned around and the fluoroscope was placed on her back, the transposed position of the heart was also very evident.

To arrive at a knowledge of the heart's condition in disease it is of importance to know its size as nearly as possible, and this can obviously be satisfactorily accomplished by means of the fluoroscope, except where pathological conditions partly obliterate the cardiac outlines as in pleurisy with effusion or œdema of the lungs for instance. Of course in very stout patients or those with pulmonary emphysema it is often impossible to determine the size of the heart by percussion, but stoutness is no serious inconvenience to an X-ray examination and emphysema is a positive advantage. In fifty-eight patients who were not stout and had no emphysema, that is to say, in whom the conditions were not unfavorable for the use of percussion, I compared the size of the heart as obtained by percussion with that obtained by an X-ray examination. The percussion lines were drawn

on the skin in blue and the other lines in black. The outlines drawn by the aid of the fluoroscope were, of course, more complete than those obtained by percussion. The percussion lines varied considerably in a portion of the cases from the size of the heart as seen in the fluoroscope. Sometimes they indicated a smaller and sometimes a larger heart than the reality. Twenty-two of the fifty-eight patients had organic disease of the heart, and a more frequent disagreement in regard to one or both borders of this organ, as obtained by percussion on the one hand and an X-ray examination on the other, was found among them than in the remaining thirty-six cases who were suffering from other than cardiac diseases. I am therefore satisfied that in some, particularly in cardiac cases, we have not determined with exactness the size of the heart by percussion, and unfortunately we cannot tell in which of our patients percussion will fail in accuracy. It is well, therefore, that we should realize this in those cases in which we desire precise information about the heart.

Let us compare these two diagrams, namely, *Heart movements* (Fig. 10) and *Aortic Insufficiency* (Fig. 11), the first of which was made from a healthy individual and the other from a patient who was unconscious of any cardiac disease, but who had a marked insufficiency of the aortic valve. It is obvious that the left side of the heart in the patient with disease of the aortic valve is much larger than normal. I could see the great left ventricle making a large excursion between systole and diastole and appreciate better than ever before what an extraordinary quantity of blood is delivered into the aorta with each systole in order to make up for the large amount which was sure to leak back during each diastole. Further, it could be distinctly seen that the excursion of the left side of the ventricle was diminished when a full breath was held, as then the heart was compressed by the lung. I refer to this patient [but it

should be stated that in aortic insufficiency the appearances may be unusually marked in the fluoroscope] in order to indicate to you that it is now possible to examine more completely than hitherto patients who have or are feared to have cardiac disease.

To carry out this new method of examination properly requires large and expensive apparatus and experience in using it with a considerable number of patients. There need be no fear of injury to any individual if the examinations are properly conducted. At the Boston City Hospital I have made more than one thousand X-ray examinations, and no one has received any injury or even inconvenience from them. It is easy to burn the fingers, if they are put too near a candle, but it is not therefore dangerous to read by its light.

This new method of examining our patients has now passed the stage of mere interest and novelty, and in its own special field, if suitable apparatus is used, can be counted among our trustworthy aids to diagnosis.

The following cases are chosen to illustrate some of the ways in which X-ray examinations may be useful in pulmonary tuberculosis:

I. George W., 36 years of age, weight 156 pounds, no change in seven or eight years. Excellent family history. His physician, Dr. John S. Phelps, gave me the following account of the case October 12, 1897:

Slight hemorrhage from the lungs in May, 1897—no physical signs. October 6th, coughed up about ʒii of blood. Examination of chest on October 7th gave no signs anywhere. Patient complained of pain in right lung. October 12th, came to me for X-ray examination, which was as follows: Right apex to upper border of third rib slightly darker than left apex. Excursion of diaphragm two and one half inches on right side (diminution from normal of one half inch); three inches on left side. October 15th, patient reported to me that Dr. Phelps had found bacilli the day before.

In this patient (II.) the signs in the fluoroscope were more marked than were the physical signs.

II. Lawrence C., 28 years of age. Entered the Boston City Hospital, April 14, 1898. Mother died of phthisis; history of several hæmoptyses. March 31, coughed up blood several times; says he lost about a pint.

April 14. Physical examination. Harsh respiration over both fronts, otherwise no physical signs.

April 14. X-ray examination: Marked darkness over upper two-thirds of left chest. Excursion of diaphragm one and one-half inches on left side; two inches on right side.

April 17. Physical examination. Respiratory sounds less pronounced than normal on both sides, otherwise no physical signs.

April 19. No change in signs by auscultation and percussion.

April 19. Second X-ray examination. Similar to that made on April 14, but more marked.

The patient was given ½ millegramme of tuberculin and reacted to it, the temperature rising to 102.4° in 18 hours.

III. George S. B., teacher, 32 years of age. Had lost a mother and one brother by tuberculosis. Hæmoptysis, June 5, 1897. In Dr. Folsom's service in Boston City Hospital for ten days. Nothing found in his chest. Subsequently to June had several slight hemorrhages. In July, Dr. Smithwick found a few small, fine râles above the right clavicle.

September 17, Dr. Smithwick found no râles at right apex, but thought he found a few in the right axilla; otherwise there were no physical signs. Said "the patient might be examined to-day without any signs of tuberculosis being detected"; no rise in temperature; no tubercle bacilli found, though the sputa have been examined several times. Dr. Smithwick brought the patient to see me on September 17.

September 17. X-ray examination: Right apex to lower border of second rib was darker than the left apex. Excursion of diaghragm on right side one and three-eighths inches; on left side two and three-eighths inches. This, together with what had gone before, led me to state I had little doubt the patient had tuberculosis.

October 3, Dr. Smithwick found tubercle bacilli.

Bacilli had been found in this patient (IV.) just before the X-ray examination was made, but it is of interest to compare the signs found in the fluoroscope with those by auscultation and percussion.

IV. The following patient has been under the careful observation of Dr. Buckingham, Dr. C. F. Withington or Dr. H. Jackson, for some months.

L. B. C., 29 years of age. Nurse in Boston City Hospital. Patient in Dr. Withington's service. Admitted May 11, 1898. For past two months patient has had cough with yellowish expectoration; about one week ago sputum was streaked with blood; slight dyspnœa after exertion. Patient thinks he has not lost weight or strength — no chilly sensation; no sweating; appetite fair.

May 11. Physical examination; heart not enlarged to the right or upward; apex in fifth space in nipple line; action regular; lungs normal save that breathing is somewhat jerky in places and fremitus is slightly increased all over right chest. Rest of physical examination was normal.

May 12. Few râles at inner edge of left scapula; no difference in fremitus or in voice.

May 14. An occasional, indeterminate râle here and there over the chest, not permanent in character; no abnormality in breathing or voice; resonance good.

May 15. Breathing very little modified qualitatively. Occasionally râles as before, and after cough they are more numerous in right axilla than elsewhere. Tubercle bacilli found in sputum.

On May 16 I was asked to make an X-ray examination, which was as follows: Whole of right lung darker than left, especially at base. Excursion of diaphragm on right side seven-eighths of an inch; on left side two and five-eighths inches.

Aug. 22, 1898. Dulness at both apices and moist bubbling râles; moist râles also present in both axillæ. Right apex, bronchial breathing with increased resonance and fremitus. Process is diffuse in both lungs but most marked in right.

X-ray examination. Right side much darker throughout than the left. Excursion of the diaphragm $\frac{1}{4}''$ on the right side, $\frac{2}{4}''$ on the left side.

The fluoroscope afforded evidence of tuberculosis (V.) where the physical signs were not conclusive.

V. Murdock M., carpenter, 23 years of age. Out-patient of Boston City Hospital, September 17, 1896. History of two hemorrhages; one four years ago and one a year ago. Now complains of pain in right chest, with slight cough and slight expectoration. Physical examination by Dr. Ames was negative, except for a few "clicks" at the junction of the second rib and the sternum on the right side and at left apex behind.

September 17, 1896. The patient was brought to me for an X-ray examination, which was as follows: Two-thirds of right lung, beginning at apex, darker than normal, as well as apex of left lung. Excursion of diaphragm shorter and higher up than normal on the right side.

October 3, 1896. Physical examination by Dr. Tenney: slight dulness at left apex, back and front, with harsh respiration and

increased voice sounds. It was learned at this time that the father and three brothers had died of phthisis.

Two examinations for tubercle bacilli had been negative.

In this case (VI.) I was in doubt as to the diagnosis until after the X-ray examination.

VI. H. C., 26 years of age, entered the hospital January 24, 1898, in Dr. Shattuck's service. Family history negative. Had not felt well for three weeks. Headache, pain in back, anorexia; pain in stomach for two weeks. Had been in bed three days prior to entrance. Epistaxis four days before entrance; bowels regular; no cough. Pulse 80. Respiration 20. Temperature 101°. Heart; right border at middle of sternum; left border three centimetres inside nipple line; apex two centimetres inside nipple line; sounds normal. Lungs; resonance and respiration good throughout; no chest symptoms whatever; spleen not felt; abdomen tympanitic; tenderness more marked on right side. Widal's serum test was made eight times, always with a negative result; leucocyte count normal; no arsenic or lead in the urine.

February 12. The patient was in my service from February 1 till his discharge. The finger ends are markedly clubbed.

X-ray examination: Both sides of chest darker than normal; no special area markedly dark, but rather the darkness was uniformly distributed. Excursion of the diaphragm: on the right side, $1\frac{3}{4}$ inches from upper border of the fourth rib to upper border of fifth rib; on the left side, $1\frac{1}{4}$ inches from middle of fourth rib to upper border of fifth rib.

February 25. Patient is losing ground; has no pain, no cough, appetite good.

March 3. Resonance: both front and back unusually good; suggests emphysema rather than consolidation; no râles.

March 4. Still losing weight; no improvement.

X-ray examination: Right side darker than left throughout. Upper two-thirds of left chest so dark that the ribs are barely seen, and only during full inspiration; diaphragm barely seen on inspiration on right side; on left side, seen only during inspiration.

March 7. Resonance over both fronts is increased rather than diminished; respiration normal, expiration not prolonged; resonance and respiration over backs normal.

March 8. Since admission the temperature has run an irregular course and the patient has grown weaker and thinner. [Four days after entrance the temperature rose to $104\frac{1}{2}$°, varied for ten days from 99° to 102°, then from 102° to 103° for six days; after which it was very irregular for several weeks, varying from normal to 103°.]

March 10. Respiration over a small area in right front, just below clavicle, is harsh; tactile fremitus slightly increased; no

râles. Resonance not so good over right base behind as elsewhere, and respiratory sounds are diminished.

March 11. *X-ray examination:* Right side darker than left during expiration; lung nearly as dark as liver; only a portion of left border of heart is seen. Diaphragm on right side moves 1 inch; on left side $1\frac{1}{8}$ inches.

March 20. There has been much improvement; patient is now up.

April 4. *X-ray examination:* Both chests clearer than at last X-ray examination; ribs can now be seen on both sides; both borders of heart seen; diaphragm on right side moves $1\frac{1}{2}$ inches; on left side, $1\frac{1}{8}$ inches.

April 19. *X-ray examination:* Outline of the heart and of all the ribs seen clearly. Excursion of the diaphragm: Right side, $1\frac{3}{8}$ inches; left side, $1\frac{1}{2}$ inches.

April 19. Temperature has been between normal and 100° for nine days, and the opportunity was given to try the tuberculin test. $\frac{1}{2}$ m. g. of tuberculin was injected; temperature rose to 102.8° eighteen hours later, and then fell to 99.5°. Malaise; patient complained of feeling sore all over.

To recapitulate: This patient's illness began about January 1, 1895. He was first thought to have typhoid fever, but later this diagnosis was regarded with suspicion. During February he failed very much, had to be fed for about three weeks, was losing in weight and strength, and I gave a very unfavorable prognosis to his relatives. On March 8 the outlook for the patient's recovery was still less hopeful, but on March 20 he was up and dressed. No definite diagnosis was made until February 12. I then examined him with the fluoroscope and made the diagnosis of acute miliary tuberculosis. On April 19, as already stated in the physical examination, he reacted to the tuberculin test. The patient was discharged on April 22. He had gained in weight and strength, although still rather thin; color good.

June 24, 1898. Has gained three pounds in the past four weeks.

X-ray examination: Excursion of diaphragm: right side, $1\frac{3}{4}$ inches; left side, $1\frac{3}{8}$ inches.

The following are references to some other papers which I have published on this subject:

Notes on X-Rays in Medicine. Transactions of the Association of American Physicians, April, 1896.

A Method of more fully determining the Outline of the Heart by means of the Fluoroscope. Boston Medical and Surgical Journal, October 1, 1896.

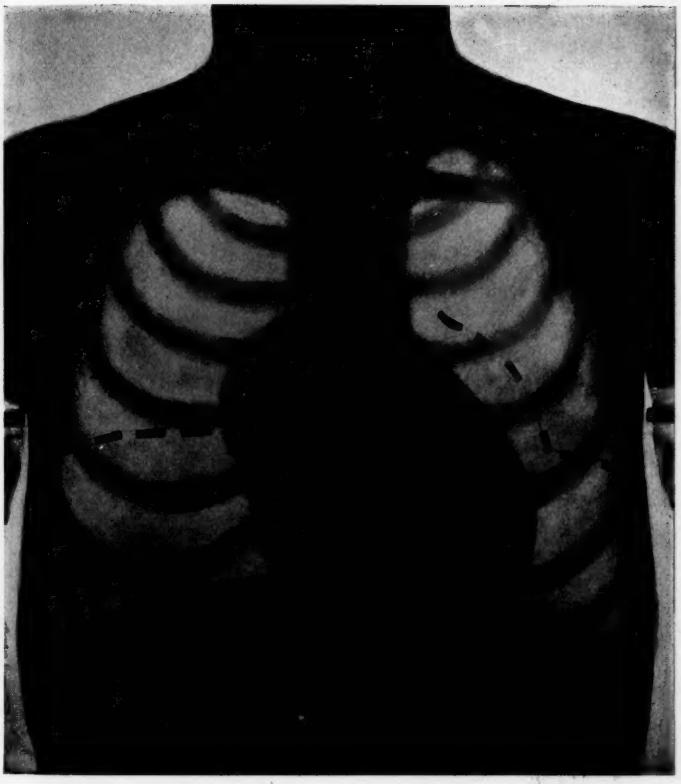

FIG. 1.—HEALTH.

In full inspiration, the broken lines show position of diaphragm and heart in expiration.

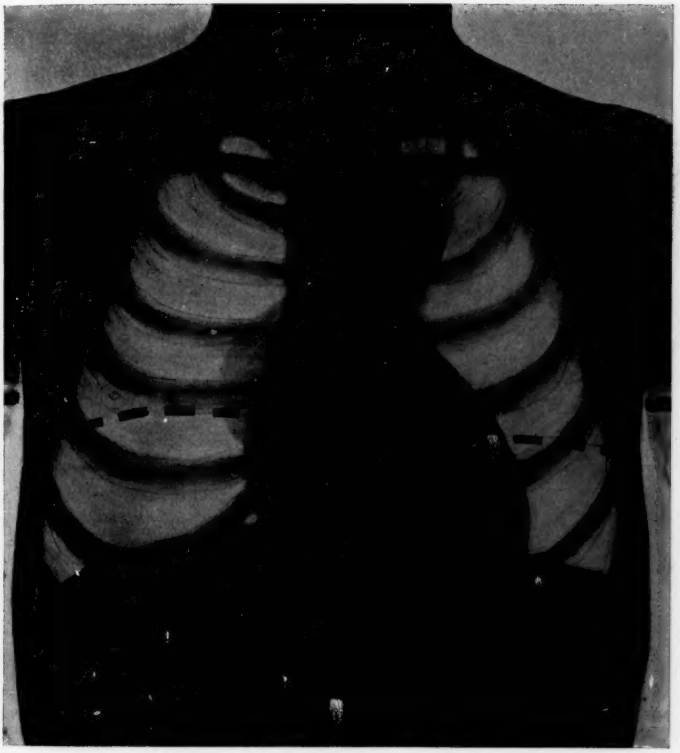

FIG. 2.—THORACIC ANEURISM.

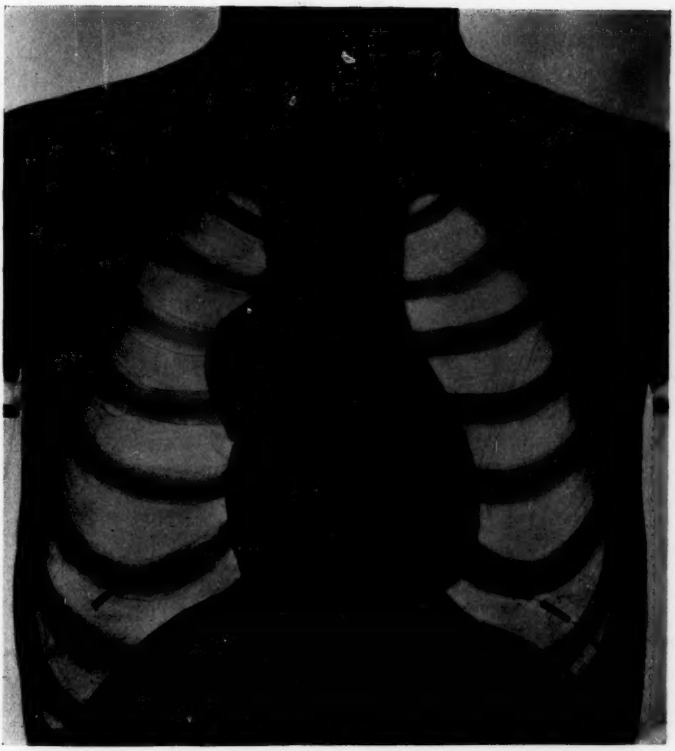

FIG. 3.—EMPHYSEMA.

In full inspiration, broken lines show position of diaphragm in expiration.

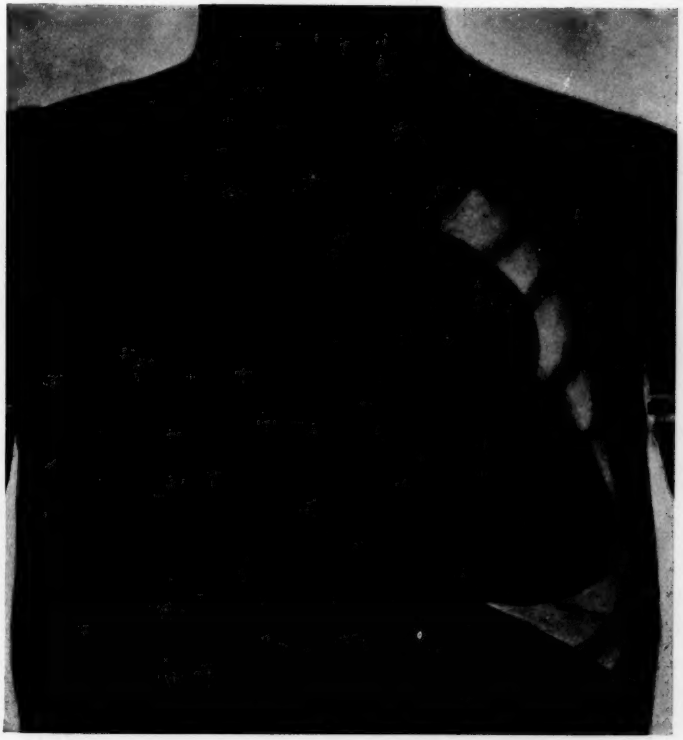

FIG. 4.—PLEURISY. With large effusion.

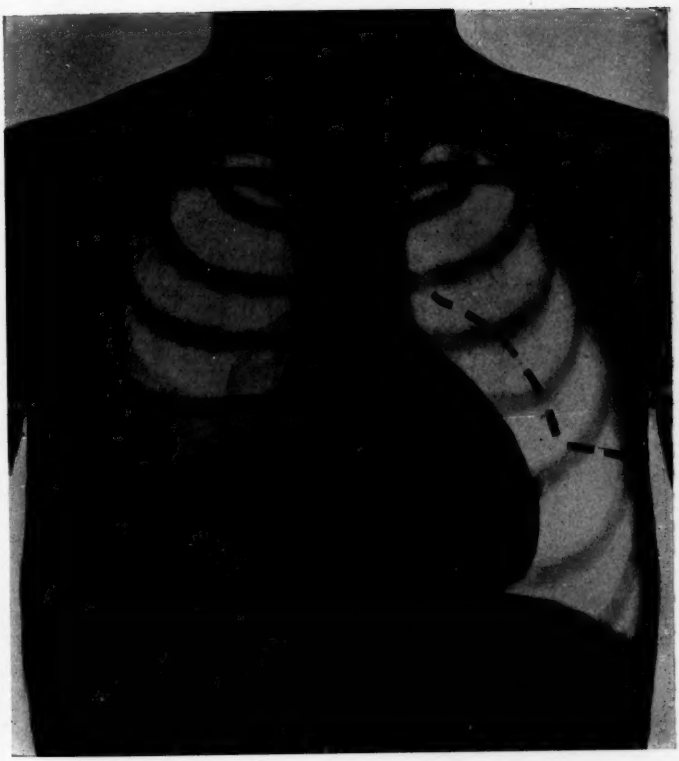

FIG. 5.—PLEURISY. With small effusion.

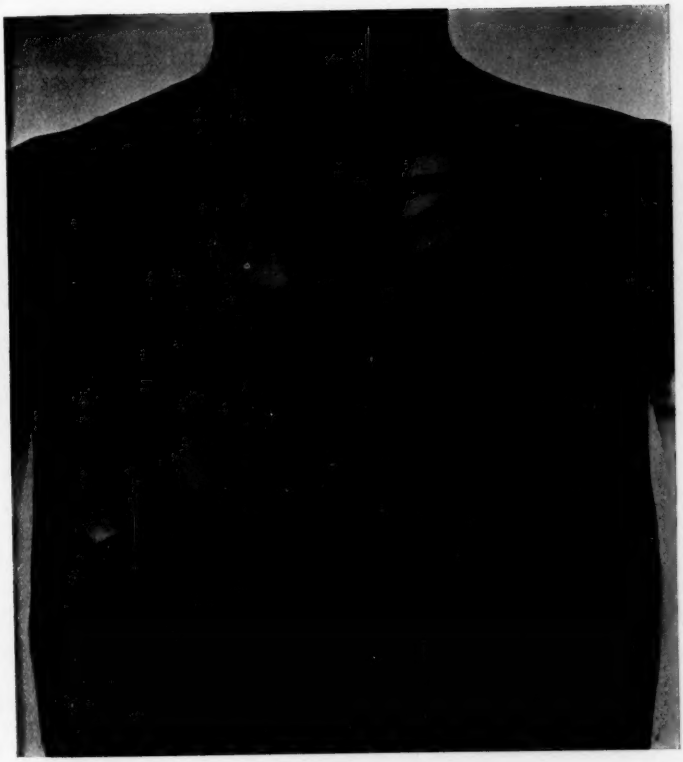

FIG. 6.—PNEUMONIA. 17th day of disease.

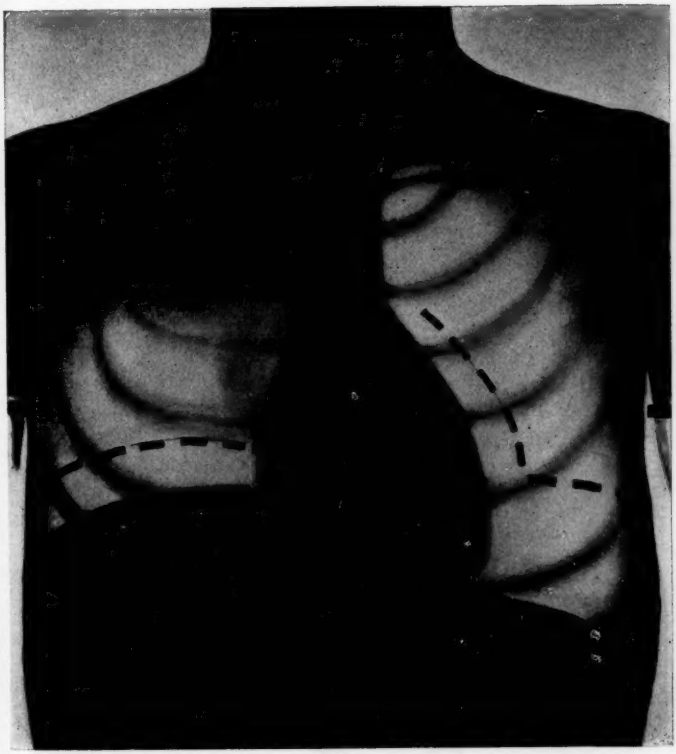

FIG. 7.—PULMONARY TUBERCULOSIS. Right side.

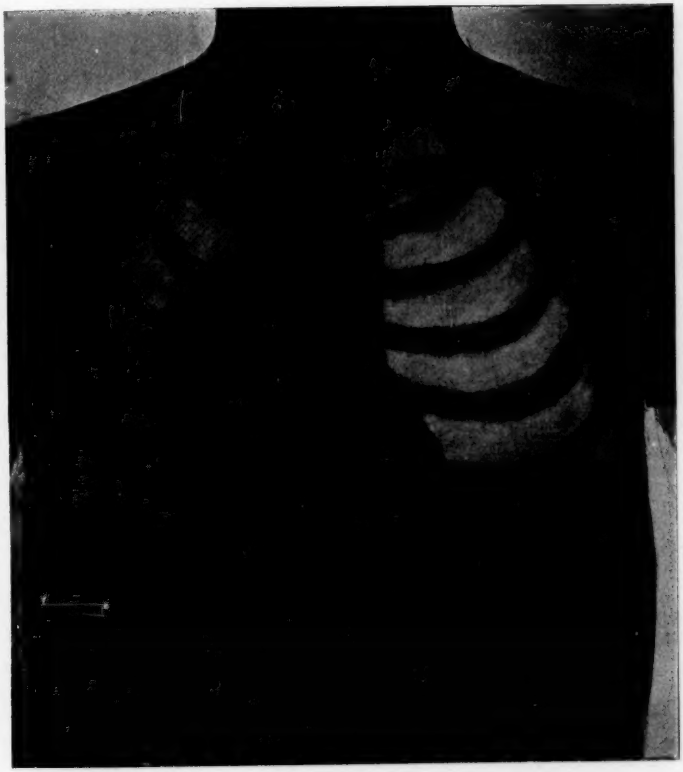

FIG. 8.—PNEUMOHYDROTHORAX. Left side.

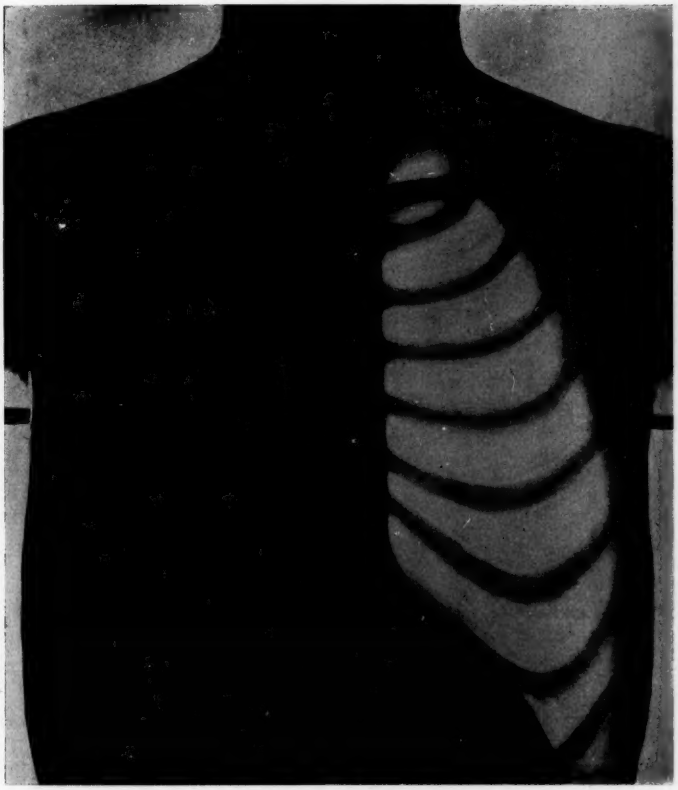

FIG. 9.—PNEUMOTHORAX ON LEFT SIDE, AND TUBERCULOSIS ON RIGHT SIDE.

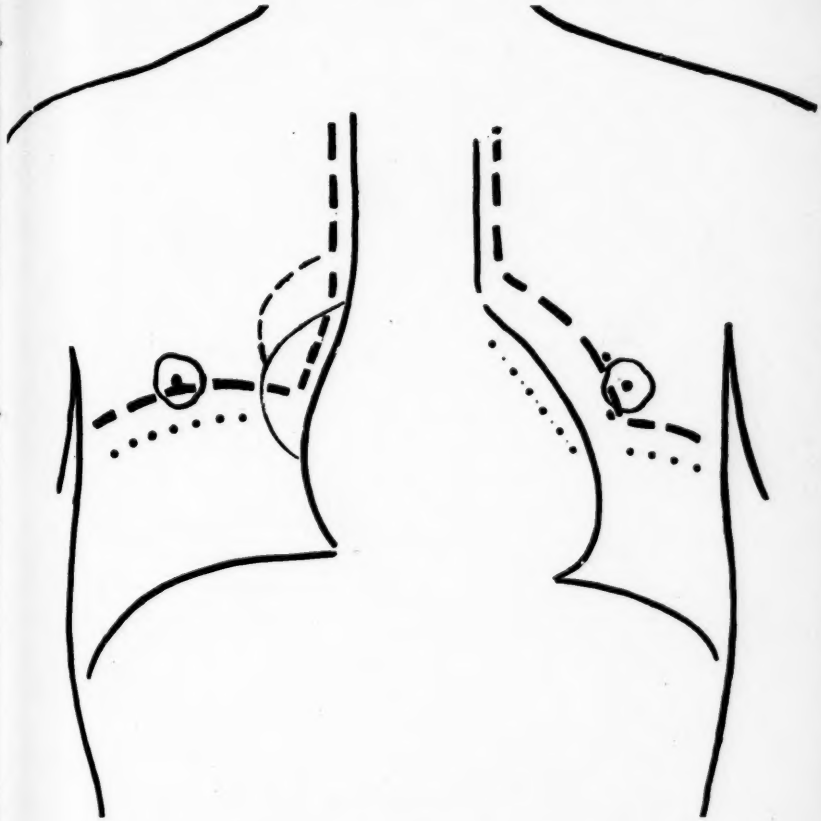

FIG. 10.—HEART MOVEMENTS.

Diagram representing the borders of the blood vessels, heart and diaphragm—the full lines in deep inspiration; the broken lines in expiration; the dotted lines just below the broken ones, the position of the diaphragm in ordinary inspiration.

The line of large and small dots inside the left border of the heart shows the position of the left border in systole; the full line in diastole during full inspiration.

It is obvious how the fluoroscope may assist to determine the position, size and mobility of the heart.

FIG. 11.—AORTIC INSUFFICIENCY.

Diagram of heart in a patient with Aortic Insufficiency. Compare with Fig. 10.

Diastole and systole during *ordinary* respiration are indicated by the arrows and the broken and the dotted lines respectively. The line made up of dashes and dots shows where the left border of the heart is in systole during deep inspiration. When a full breath is taken the heart is compressed, and the diastolic excursion is less than in ordinary breathing. The movements of the heart could be followed in this patient unusually well.

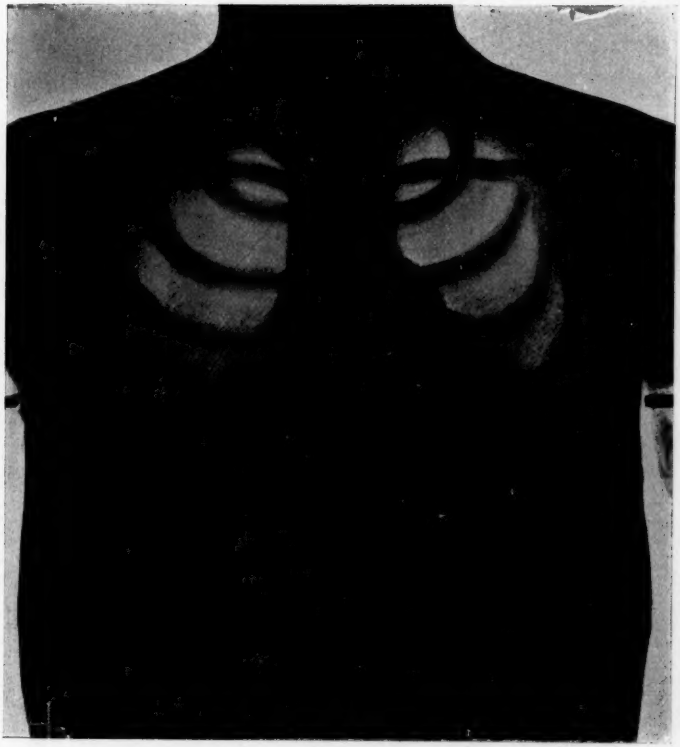

FIG. 12.—PASSIVE CONGESTION OR ŒDEMA OF THE LUNGS.

A Study of the Adaptation of the X-Rays to Medical Practice. Medical and Surgical Reports of the Boston City Hospital, January, 1897.

Some Medical Uses of the Rœntgen Rays. Read in the Section of Medicine at the Annual Meeting of the British Medical Association, September, 1897.

The Rœntgen Rays in Thoracic Diseases. Medical Communications of The Massachusetts Medical Society, 1897, and American Journal of Medical Sciences, December, 1897.

X-Rays in Medicine. Read by invitation at the Annual Meeting of the Medical Society of the State of New York, January, 1898. Transactions of that Society for 1898, and Medical News, May 14, 1898.

Erratum.

On page 868, the sentence beginning on the eighth line should read:

The X-rays do not burn, and there need be no fear of injury from the accompanying electrical discharge to any individual if the examinations are properly conducted.

ARTICLE LIII.

THE PATHOLOGY OF ACUTE INFECTIOUS OSTEOMYELITIS.

By EDWARD H. NICHOLS, M.D.
OF BOSTON.

READ JUNE 7, 1898.

THE PATHOLOGY OF ACUTE INFECTIOUS OSTEOMYELITIS.

THE following description is based chiefly upon a series of observations made during the past three years. Twenty cases of osteomyelitis have been examined. The specimens have been obtained from early amputations and from excisions of bones at various stages of the disease. I am indebted to the surgeons of the Children's and Boston City Hospitals for much valuable material.

Definition.—Acute infectious osteomyelitis is an acute suppurative inflammation of bone, and always is due to infection of the bone by micro-organisms. The process has been described as "furunculosis" of bone, but the inflammatory process is modified by the peculiar anatomy of bone. The ordinary furuncle is due to the infection of a hair follicle by the staphylococcus aureus. The organism causes a necrosis of the subcutaneous tissue surrounding the follicle. The necrotic tissue quickly is invaded by polymorphonuclear leucocytes, and is dissolved, so that an abscess is formed. Such a furuncle is superficial, and the abscess contents discharge spontaneously, or may be reached by a slight incision. In osteomyelitis the general process of infection, necrosis, leucocytosis and solution is the same, but the process begins in the marrow spaces which communicate freely with each other, and the area of inflammation is enclosed by a shell of dense cortical bone. So in osteomyelitis the process quickly may extend over an entire bone; the products of the inflammation are retained, so that dan-

ger of general infection is increased; and the focus of the disease can be reached only by an extensive operation.

Cause.—The direct cause of acute infectious osteomyelitis always is an infection by a pathogenic organism. The staphylococcus pyogenes aureus is by far the most frequent cause of the disease, as all observers agree. For instance, *† of one hundred and thirty cases of osteomyelitis one hundred and three were due to the staphylococcus aureus. In all but two of the cases I have seen the staphylococcus aureus was present in pure culture. Sometimes the staphylococcus albus or citreus is the cause. Occasionally the inflammation is produced by the streptococcus pyogenes, especially in new-born infants of mothers who have puerperal septicæmia. Not infrequently the ‡pneumococcus of Fränkel causes osteomyelitis. I have seen one such case, following a pneumococcus empyema. More frequent than pneumococcus osteomyelitis is osteomyelitis due to the typhoid bacillus. §Keen has collected thirty-eight cases of osteomyelitis produced by the typhoid bacillus, and in fourteen of these cases the bacillus was in pure culture. Whatever organism causes the disease that organism generally is in pure culture, but sometimes a mixed infection occurs, and such cases usually are very severe. In long continued osteomyelitis with open sinuses, various pathogenic and non-pathogenic organisms may be present. I once have found the bacillus fetidus in such a case.

So, on the whole, it may be said that osteomyelitis is not a specific disease, but that it is an acute inflammation that may be caused by any one of a variety of pathogenic micro-organisms, or by a mixed infection.

* Lannelongue. Statistique Microbienne de l'Ostéomyélite Aiguë. Rev. de Chir. 1895.

† Lannelongue and Achard. Sur la Présence du Staphylococ. Citreus dans un Ancien Foyer d'Ostéomyélite. Arch. de Méd. Exper et d'Anat. Path. 1892.

‡ Fischer and Levy. Bacteriolog. Befund bei Osteomyelitis und Periostitis. Dtsch. Zeitschr. f. Chir. 1893.

§ Keen. Surgical Complications and Sequels of Typhoid Fever. 1898.

Animal Experiments.—This statement is proved by experiments upon animals by many observers. They have produced characteristic osteomyelitic lesions in the bones of animals by injecting various pathogenic organisms into the blood vessels, so that the organisms were carried directly to the bones; or by injecting the organisms directly into the bone marrow; or by fracturing the bones and innoculating the animals. In the latter case the osteomyelitis was produced at the point of fracture. In such experiments the disease has been produced by the staphylococcus pyogenes aureus,*†‡ also by the streptococcus pyogenes, the pneumococcus and the typhoid bacillus. § Ackermann has caused osteomyelitis in animals by injecting large numbers of colon bacilli. Ullmann produced sterile abscesses of bone by injecting calomel directly into bone marrow.

The gross and microscopic appearances of these experimental lesions are the same no matter what the cause. This usually is true of human osteomyelitis, although it is claimed that osteomyelitis due to the streptococcus is characterized by extreme redness of the skin and swelling of the lymph glands, and by the early formation of large purulent areas in the bone. Others claim that the appearance of the disease does not depend upon the nature of the organism.

Predisposing Causes.—Certain general causes favor the occurrence of osteomyelitis. The disease comes generally in individuals whose bones have not attained complete development, *i. e.*, in children or adolescents. About one-half of the cases occur between the ages of thirteen and seventeen. The disease also occurs in boys about three times as often as in girls. The disease frequently follows extreme fatigue and exposure to cold. Osteomyelitis fre-

*Lexer. Experiment. Erzeugung osteomyelitischer Herde. Dtsch. Med. Wochenschr. 16, 1894.

† Ullmann. Beiträge zur Lehre von der Osteomyelitis acuta. Wien.

‡ Lannelongue und Achard. loc. cit.

§ Ackermann. Lésions Ostéomyélitiques provoquées par le Bact. Coli Comm. Arch. de Méd. Exp. et d'Anat. Path. 1895.

quently occurs subsequent to an attack of some infectious disease, *e. g.*, measles, scarlet fever or pneumonia, sometimes after diphtheria, and quite frequently after typhoid fever. Cases of osteomyelitis which follow the exanthemata usually are due to a secondary infection by pyogenic organisms, but osteomyelitis which follows typhoid fever often is due to infection of the bone by the typhoid bacillus. Osteomyelitis often occurs after slight injuries, *e. g.*, bruises or contusions of the affected bone, although there may be no visible break in the skin.

Method of infection.—The infection of the bone often is secondary to a local infection of some other part of the body, *e.g.*, furuncle or ulcer, *i.e.*, the infection takes place through the skin, and the organism reaches the bone by the blood. In some cases the infectious organisms enter the body through tbe respiratory tract, *e.g.*, in osteomyelitis caused by the pneumococcus, secondary to a pneumonia. Infection through the intestinal tract, except by the typhoid bacillus, is said to be rare. Ullmann fractured the bones of animals, and then fed them on infected food, but was unable to produce the disease. Often osteomyelitis appears to be primary, and the point at which infection occurs cannot be detected.

Location.—Osteomyelitis usually begins in the shaft of the large long bones, near the epiphyseal line, while tuberculosis generally begins in the epiphysis. Osteomyelitis, however, may begin in the epiphysis, and simulate acute tubercular disease. The femur is the bone most often attacked, then the tibia and humerus, but no bone is exempt, and short and flat bones may be affected. Usually only one bone is diseased, but sometimes two, and rarely several bones are attacked. After the disease begins in one bone other bones may become involved after an interval of days or weeks.

Anatomy.—Osteomyelitis generally begins in the bone marrow. The infectious organism is deposited in the mar-

row, and produces a soluble toxine which causes a necrosis of the adjacent cells. At this time, to the naked eye, the marrow is little changed, but microscopic examination shows that the cells are necrotic, their nuclei do not stain, and large numbers of micro-organisms are present in the necrotic tissue. Into the necrotic area comes an extensive exudation of polymorphonuclear leucocytes, and the necrotic tissue dissolves, while blood vessels are injected, and numerous more or less extensive hemorrhages may occur. There is comparatively little fibrin formation. At this time, on section of the bone, one sees one or several circumscribed, irregular, yellow or greenish yellow areas of infiltrated, dissolving marrow, alternating with dark red areas of hyperæmia and hemorrhage. From the original focus the process may extend along the marrow spaces, until in severe cases, the whole medullary cavity is involved.

Usually the suppuration extends through the Haversian canals of the cortical bone to the deep layers of the periosteum. If this happens the periosteum is injected and its deeper layers are yellowish from purulent infiltration. The pus may collect in large amounts between the bone and periosteum, and push up the periosteum from the bone, sometimes over large areas, so that the entire shaft, between the epiphyses, is bare. At this time the periosteum is thick, injected, and its inner surface is covered with shreds. The bone may be ivory white, or somewhat injected. The pus between bone and periosteum usually is thin and yellow, or it may be red from hemorrhage, and it usually contains numerous fat drops, derived from the necrotic marrow.

The periosteum may be perforated at one or several points, and the infection may extend to the adjacent soft parts, and cause an area of diffuse suppuration, which may open upon the surface by one or more sinuses.

The inflammation of the bone marrow may extend as far as the epiphysis. Often the epiphyseal line offers a considerable hindrance to the further extension of the disease. Sometimes the epiphyseal cartilage is destroyed, and the epiphysis may be separated from the shaft, "spontaneous fracture." Both epiphyses of a bone may be separated in this way. Or the suppuration may extend through the epiphyseal line, and destroy the epiphysis more or less completely. The suppuration in the epiphysis may extend to the articular cartilage, or the cartilage may be destroyed, so that the infection reaches the joint, and causes greater or less suppuration and destruction of the joint.

Sequestrum Formation.—As a result of the inflammation of the marrow or of the stripping of the periosteum, or of both, there often occurs a necrosis of larger or smaller portions of the cortical bone. The necrotic cortex becomes a dirty yellow, in contrast with the ivory white or injected living bone. If the whole periosteum is elevated, and the marrow is in filtrated, the entire shaft may become necrotic. Or only a portion of the cortex may die. The necrosis may be superficial, or a portion of the inner layer of the cortex may die, and form an "internal sequestrum."

At times the suppurative process in the marrow may be sharply limited, and form a circumscribed bone abscess. Such cases rarely are seen in the shaft, but are not uncommon in the epiphyseal ends.

Early in the acute stages fat embolism may occur. Fat globules from the necrotic marrow may get into the general circulation, and be lodged in and occlude the pulmonary capillaries. Often in severe cases the patients die of toxæmia or septicæmia, before any considerable area of suppuration forms. Frequently the organism gets into the general circulation, and produces metastatic abscesses in the lungs, liver, kidneys, spleen and heart.

Repair.—Osteomyelitis may be self-limited or checked by operation, and in that case repair takes place. In the marrow spaces which surround the area of suppuration comes a formation of œdematous granulation tissue, in which are many lymphoid and plasma cells. Also there comes a marked osteoblastic thickening of the adjacent bony trabeculæ, so that finally the necrotic area in the spongy bone is shut off from the uninfected marrow by a wall of granulation tissue or of granulation tissue and sclerosing bone, which may extend completely across the medullary canal. The granulation tissue at length is converted into dense fibrous tissue, while the sclerosis of bone becomes extreme so that the necrotic bone, or bone abscess, may be entirely enclosed by a box of dense bone. An area of necrosis in spongy bone may persist for years, entirely surrounded by dense bone, or opening upon the surface by one or more sinuses.

If the cortex of the bone becomes necrotic the dead portion is separated from the living by the action of osteoclasts, and the medullary canal about the ends of the sequestrum is closed by fibrous tissue and sclerotic bone formed in the manner thus described.

If the osteomyelitis is severe, and cortical bone is necrotic, the periosteum thickens and forms new periosteal bone in its deeper layers. This formation of periosteal bone takes place peripherally, and the layer of bone may become one or more centimeters thick. At first this periosteal shell is loosely attached to the cortical bone, and can be separated easily with an elevator. If the periosteum is examined six or eight weeks after the beginning of the disease it appears pink and thickened, and the surface next the original shaft is covered with thin, fragile, irregular plates of bone. If the cortical bone beneath this periosteal shell is alive the periosteal bone may at length adhere closely to it, and cause a thickening of the bone at that point. If, however, the

cortical bone is necrotic it becomes separated from the periosteal bone, and forms a sequestrum, which in time is completely surrounded by a shell of periosteal bone lined with granulation tissue. This shell may be perforated by numerous fistulæ, opening upon the surface of the body. The vascular periosteal bone shell finally becomes sclerotic bone, and the ends of the shells are closed by sclerotic bone, formed in the manner already described.

Such a sequestrum may persist for years, act as a foreign body, and maintain a chronic inflammation; or it may disintegrate and be discharged piecemeal, and leave a cavity with walls of sclerotic bone lined with granulation tissue. Such a cavity, as every surgeon knows, shows little tendency to heal, and various operations have been devised to close such cavities, with indifferent success. If small sequestra in spongy bone are removed the cavity often becomes filled with bone, and complete healing takes place.

If the infectious process attacks the joint repair is brought about by the formation of granulation tissue, which may cause extensive adhesions, or complete anchylosis of the joint.

If the epiphyseal cartilage is destroyed the further development of the affected end of the bone may be hindered or completely checked, so that the bone remains shorter than normal.

Surgical Indications.—The indications for surgical treatment as shown by the pathological conditions vary with the different stages of the disease.

In the acute stage there is an acute infection of the marrow of the bone, which, if not checked, may cause entire destruction of the affected bone and adjacent joints, or may cause a fatal toxæmia or a general infection. So, as in other acute local infections, the infected area must be opened and thoroughly drained, not only by an incision into affected soft tissues and sub-periosteal abscess, but also by an opening into the infected bone marrow.

In the subacute stage, especially in severe cases, the condition is different. The marrow is already drained through spontaneous or artificial openings, the cortical bone is necrotic over more or less extensive areas, while the periosteum is thickened, and bone plates are formed in its deeper layers. These conditions are marked at about the sixth or eighth week. In a certain number of cases in which the greater portion of the shaft is destroyed it is desirable to strip the periosteum and remove the entire shaft between the epiphyseal lines, and to approximate the inner bony surfaces of the thickened periosteum. In this way the formation of a sequestrum is avoided, and, by adhesion of the periosteal surfaces and deposition of periosteal bone, a new bony shaft will form.

In the chronic stage it is to be remembered that, if the original shaft forms the sequestrum, it is included in a box of dense sclerotic bone, lined with granulation tissue. When such a sequestrum is removed there is little tendency for such a cavity to heal, and it may remain for months or years. Repair fails because the sclerotic bone is but slightly vascular, and there is little attempt to form new bone. The condition is analogous to that of a chronic ulcer. Such a cavity should be filled with tissue which has a tendency to repair. Neuber has inverted flaps of skin from either side and fastened them to the bottom of the cavity. Schede has used aseptic blood clot. If the sequestrum is a superficial one the defect in the bone may be covered by a transplanted skin flap. Decalcified bone chips have been used. It seems probable that, after removal of the sequestrum, if the sclerotic bone at either end of the cavity were removed until vascular marrow was reached repair from the marrow might be active enough to fill the gap in the bone. Sometimes, however, the sclerosis of the shaft is so extreme, as to make it impossible to reach normal marrow.

SUMMARY.

1. Acute infectious osteomyelitis is an acute inflammation of bone, due to any one of a number of pathogenic organisms. Hence osteomyelitis is not a specific disease.

2. The staphylococcus pyogenes aureus is the organism that most commonly produces the disease.

3. Youth, and the exanthemata, predispose to osteomyelitis.

4. Osteomyelitis generally attacks the shaft of bone, tuberculosis generally the epiphysis.

5. The process may attack the epiphysis and extend to the joint.

6. Sequestrum formation is usual.

7. Repair is due to the formation of granulation tissue, sclerosing bone, and of periosteal new bone.

8. Surgical indications are three:

In the acute stage the infected bone area must be opened and drained.

In the subacute stage in suitable cases the shaft may be removed, and the inner layers of the periosteum approximated, and a new shaft of bone will form.

In the chronic stage the cavity must be filled with material which tends to repair. It seems desirable, when possible, to remove sclerotic bone, so that the marrow may have an opportunity to form new bone, and fill the defect.

ARTICLE LIV.

THE SHATTUCK LECTURE.

THE INFLUENCE OF THE NORTH AMERICAN CLIMATE ON THE PEOPLE.

By Sir WILLIAM H. HINGSTON, M.D.
OF MONTREAL, CANADA.

DELIVERED JUNE 7, 1898.

THE INFLUENCE OF THE NORTH AMERICAN CLIMATE ON THE PEOPLE.

ALLOW me to thank you for the honorable task you have given me of appearing before you, and of addressing so large and so cultivated a body of men in this most interesting seat of erudition and culture, where, as in Athens of old, to be a citizen was to be credited with the possession of learning and refinement.

And now, gentlemen, that I have been so bold as to leave my northern home, and to cross a line which diplomatists have set up as limitations to our respective territories, but which science, with all its modern aids to vision, yet fails to perceive, allow me to say: vague and undefined as shadowless night was the thought of what I should utter, until one — whose memory, I am sure, well deserves to remain green amongst you — wrote to me thus: "Do not worry yourself too much about your choice of subject for your address. I think you can really make a good thing out of climate. There is enough of it in New England, if there is not in Canada, both of which, I think, have as good climates as any in the world, and have fewer great scourges to suffer, and as little disease, sporadically, as is consistent with the plan of Creation."

Here, very much abridged, is the last will and testament of my beloved friend — Dr. Cotting — who little dreamed the words I have quoted, written to me, as events proved, from his death bed, would be made responsible for the choice of my subject.

In plunging at once into the theme selected, I must premise: firstly, that some of the earlier portions of my paper must necessarily be of a somewhat elementary character; and, secondly, that as the territory is vast, everything relating to it is commensurably great and cannot be compressed within too narrow limits to be appreciable.

What is climate, and upon what does it depend? It is not alone the thermometrical, the barometrical or the hygrometrical bearings of a country. These features form a part, but often the least important part; and as they may be found recorded in many of our scientific periodicals, they need not be more than alluded to here. It is not alone that obliquity of the sphere with respect to the horizon from which results the inequality of day and night; nor the spaces between the imaginary circles, parallel to the equator; nor the weather peculiar to a given country. The term includes all the changes in the atmosphere which sensibly affect our organs, and which exert an influence on the feelings and mental condition of man.

Heat is the controlling condition of all climates, but the interposition of the atmosphere modifies all the effects of the sun's rays, while the atmosphere itself is in turn modified by the surface of the globe. Were our country possessed of a smooth, even surface, and were its crust composed of the same uniform material, its climate would be of equal temperature, and would bear a definite relation to the sun's influence. But the crust of the earth is not uniform in surface. It abounds in mountains, plains and valleys, distributed, seemingly, in a very irregular manner, but, in reality, with wonderful wisdom. Portions are overshadowed with forest; others are destitute of it; portions are covered with lakes, rivers and inland seas; an elastic atmosphere rests upon the whole, and every portion is permeated by electricity.

In the sun reside the forces on which all the phenomena

of climate depend; and the rays of heat and light are the efficient agents by which its influence is exerted. When the sun's rays reach the earth, they are substantially according to the angle of incidence. But as they fall on material, most diversified, those movements which we observe in the atmosphere are generated.

The elements of climate are not always the same in different regions. They bear an intimate relation to the physical geography of a country. Thus, we may have unequal degrees of heat in portions of our land having precisely the same latitude, but different degrees of elevation; or, with the same elevation, as they are covered by water or by forest, or are destitute of shade.

There is also an intimate relationship in health and strength, and mental and bodily vigor, between the inhabitant of a country and the country which he inhabits. "As is the air, such are our humors," is an adage handed down to us from remote antiquity. "Residents of warm climates," says Leo, "are ordinarily so choleric in their speech that scarce two words pass without railing or chiding in common talk; and often quarrelling in the streets." "Cold air," says another, "is almost as bad as hot, and the people of northern countries are generally dull and heavy." "In a thick and cloudy air," says Lemnius, "men are tetric, sad and peevish; and if the westerly winds blow, there is a kind of alacrity in men's minds; it cheers up men and beasts. But if it be a rough, heavy, cloudy, stormy weather, men are sad, lumpish and much dejected, angry, waspish, dull and melancholy." A thousand quotations from observers of many countries, and of all periods, might be cited to the same purpose.

The influence of climate on animals and vegetables is unquestioned. We recognize its influence on our minds and bodies; on our stature, strength and complexion; in causing and curing disease; and in prolonging or shorten-

ing life. There is a connection between the ratio of mortality of a country and its physical geography. But the influence of climate is most marked, when least hindered by other conditions. In some instances, where climate is permitted freedom of action it does not require a long continued operation to effect certain changes. It affects the national character materially, when the inhabitants are in a natural state, and so long as they preserve that state; while the condition of others, when modified by cultivation, may be less influenced. Cultivation, itself, is constantly developing intellectual endowments, hitherto latent.

Man is better suited to a variety of climate than is any other animal; or, to state it otherwise: the mutability of his physical form has a wider circle. But for this relative immunity, he is indebted, rather to the ingenuity of his mind, than to the pliability of his body. It requires a longer period for climate to produce changes in man than in vegetables or in the lower order of animals, for man protects himself better against the vicissitudes of climate than the latter. "The same human race," says Waitz, "can successively live in different climates, and the whole mode of life and external conditions to which the same race may be subject, may be essentially altered—not so those of animals." With the latter the range is more limited, and it is reached in a shorter period.

A few words are here necessary as to the physical geography of the country we inhabit. (I throw aside, for the moment, as altogether irrelevant, our relative political states, and shall speak of the inhabitants of the two countries as forming, ethnographically, one people.) We occupy what has been styled the interior valley of North America — a valley which may be estimated at six million square miles, or, in round numbers, three-fourths of the area of North America — a valley which begins within the tropics, and terminates within the polar circle traversing

the continent from north to south, and passing through the whole northern zone. This valley is indented, here and there, with great bodies of water; the Gulf of Mexico in the south; and the Mississippi, the Missouri, and a number of other rivers flowing into it; and in the north by the Hudson Bay, which approaches within 22 degrees of latitude of the former. It is indented also by great fresh water seas, Superior, Huron, Michigan, Erie, Ontario and others in countless number to the north; and by rivers of commensurate magnitude. The Rocky Mountains (from ten to fourteen thousand feet high), bounding this valley from the Pacific Ocean, begin beyond the polar circle and end in the Mexican Cordilleras. The less elevated Appalachian Mountains bounding the valley in the east, are here and there interrupted. The valley is therefore more open to, and is more influenced directly by the Atlantic than by the Pacific, although in rain supply it is otherwise.

The size and shape of this country exercise important influence in controlling its heat. The greater the land surface, the greater the measure of heat. Our continent widens as we descend in latitude, and we find the centre of the system of atmospheric circulation north of the geographical equator. Our Arctic and subarctic regions are colder than are those of Europe.

"The refrigeration at the extreme north of this continent," says Blodgett, "is excessive in winter, and there is no accumulated or accumulating heat at the south to balance it, as the land narrows so rapidly. There is no Africa, Arabia and India to compensate our Siberia (Alaska), and consequently the continent as a whole is below that of the eastern hemisphere in temperature. The eastern hemisphere has a very large land area at the border of the tropics, while this hemisphere has very little; and, as the effect of land areas, to increase the temperature by accumulation, or to diminish it by radiation, depends wholly

on the sun's altitude, the middle latitudes may be softened in winter temperature by land at the north, and such is evidently the case with the north of Europe."

The low elevation of this Continent is favorable to animal and vegetable life. On the north coast were the plateaus much elevated, vegetation would be confined to the mosses, and animal life to a few, thinly scattered, thick-furred animals. The gentle slopes are toward the Atlantic; the abrupt and elevated are toward the Pacific. Land, in this part of the world, ascends in a series of plateaus; and the height of table land is reached to the south of Hudson Bay.

The vast lakes and rivers exert unmeasured influence upon the climate. Their surfaces are constantly experiencing changes in temperature, but, at certain depths, the temperature, in winter, and in summer, is the same. The beds of the more profound bodies of water remain perpetually cold — their surfaces alone experiencing any variation of temperature. While receiving its normal quantity of heat from the sun, the water of our lakes is colder than the land during the day, and warmer during the night. In summer the water is colder than the air, in winter it is warmer. Our great lakes preserve a mean temperature; while the land experiences the extremes.

This portion of the Continent, like the north of Europe, is, in climatic features, both continental and oceanic. At the place where we are now assembled, the oceanic features are the more marked; but they are limited in area to a somewhat narrow fringe, and are lost, in the continental, at a short distance from the coast. The continental features predominate almost to the shores of the Atlantic, and to the banks of the great lakes; yet it is to the modification caused by the latter that we are indebted for so great a range of animal and vegetable life.

The extreme heat of summer would give to this country a still more continental climate, were it not associated with profuse rains at regular intervals.

Our weather prophets have exceptional advantages in framing the twenty-four hours probabilities, in that the changes which occur in one part sweep with a regular progression to other and more distant parts, intervening parts modifying and retarding but little that progression. "The changes of temperature and the oscillations of every sort," says Blodgett, "strike this portion of the continent as changes would over any plane surface." They are systematically uniform, and "knowing what they are in a few places, we may easily infer what they have been, or will be, at all."

Our climate has been compared to that of Turkey or of Paris in summer, and to parts of Russia in winter; but there is a uniformity here which is not met with in Europe or in Asia: the meteorological differences are such as are produced by position alone. The oscillations in temperature are greater and more frequent in summer than in winter.

The climate in this part of the country is supposed to be drier than that of most parts of Europe. On the contrary, more rain falls here than there, but here it falls in shorter periods, and in larger quantities at a time.

The seasons of the year are here less defined than they are in Europe. It has always appeared to me that the usual division of the year into seasons is not suited to this country. The Indian of the north measures his life by the summers; we measure ours by the winters. Our seasons are four; his are five. His first season is winter; when the temperature moderates, it is the season of water-drops; later still, it is that of thaws; later still, that of no ice, even in the extreme north; and the last season is the fall.

Meteorological tables show a regular progressive advance in temperature from January to July; and a falling scale from that period until the lowest temperature is again reached in January. But the period at which the sap begins to ascend in the trees; the period at which animals leave their winter haunts for river banks or marshes; the

period at which the feathered tribes change their plumage and their habitations, are marked by steady, uniform progression, more regular than are the changes in temperature. We are accustomed to speak of early seasons and late seasons, but the advent and the departure of our summer birds, which winter elsewhere, are remarkable for regularity.

Dr. Rae, in his search for Sir John Franklin, once told me he was accustomed, on the twenty-second of April, to promise the men of his party wild goose for their St. George's dinner, on the following day, and he never disappointed them. Yet there were no birds in view on the 22d; but on the morning of the 23d he rose early, took his gun; and in the early dawn would invariably descry the feathered ones skimming the horizon, when some of them were brought down. Elsewhere I have recorded the movements of many of the birds which hibernate not with us, and the regularity of their advent and of their departure.

The late Dr. Smallwood, practising medicine on an island nine miles west of Montreal, noticed during seven successive years that the hoarse croak of the frog was heard, for the first time, on the 23d of April, the day of the year on which Dr. Rae, in the north, shot his first wild goose. Yet the condition of the ground in which this small amphibian had passed the winter in a state of torpidity was not always the same. Something, therefore, beside temperature, either of the earth, or of the air, must have incited and impelled those movements.

The thermometer is but an imperfect guide to the sensible condition of the atmosphere. Our bodies do not always take quick cognizance of modifications of its heat, for the hygrometric condition of the atmosphere and the state of the winds have much to do with sensible temperature. In no part of this continent is it ever too cold for out-door occupation, provided the wind is at rest. Arctic travellers have often been reduced to the necessity of sleep-

ing in the open air with a single blanket, when the thermometer was 50 to 70 degrees Fahrenheit below freezing point. The discomfort of this severe cold has not been infrequently increased by the practice of the men laying long leathern bottles of snow, to be liquified, between every two sleepers.

Climate and vegetation stand in close relation to each other. The presence or absence of natural woods is a fair guide to the kind and quality of climate. With us the mixed forest exists in marvellous luxuriance; and while, on the one hand, thick umbrageous leaves are met with in more southern parts, steadily diminishing in size, till in the more northern parts they are rolled up so as scarcely to ward off any of the sun's rays, yet "from one end of the country to the other, shrunken leaves and feeble stems are nowhere to be met with."

The depth to which our grasses permeate the earth show that they have not their roots near the surface, to spring up after a short rain, and to wither again when the superficial moisture is exhausted. With us rains occur at somewhat regular intervals, and are sufficiently abundant, and sink sufficiently deeply to nourish the roots of the monarchs of the forest.

The variety of flowers is almost endless, and in color they are as bright as can well be conceived. Cereals are grown in such quantities as not only to feed our own people, but to go far to nourish the hungry of other lands. In, perhaps, no other country of the world is there a greater variety of fruit. Here, where we are met, are found the fruits of cold, temperate and warm climates.

Climate is influenced largely by forest and herbage, and any change affecting vegetation affects the climate; while vegetation is affected again in return. Some meteorologists deny, however, even this partial influence, but it is recognized by many observant men.

To what extent will the removal of the woods and forests affect the climate of this country? It may be said, on the one hand, that the qualities of climate are permanent; that vegetation is the effect of climate, not its cause; that so long as the sun continues to give out his accustomed heat, and that so long as hills and mountains, rivers and valleys exist, so long will the permanent conditions of climate obtain. We may be told that the temperature of countries, like Egypt, has not changed since the time of Moses.

On the other hand, it is admitted that parts of Europe—France and England especially—have undergone great modifications in temperature, even in historic times, and that changes have occurred in the temperature of North America in many places.

This continent was once covered with ice a mile in thickness. Of this there can be no doubt. The slopes of the Alleghany range of mountains were once covered with ice to the very top, except at a few points which were above the level of the icy commons. "Rounded and polished surfaces are often found in the older rocks, favoring the supposition that they have been caused by the action of the glaciers all along the Laurentian hills from Lake Superior to Labrador," says Sir William Logan, who gives descriptions of appearances which have forced him to this conclusion.

The rough and unpolished surface of Mount Washington is in some places covered with loose fragments; then its glacier marks come to an end, telling us that it lifted its head, alone, above the desolate waste of icy snow. When the peaks are much below 6,000 feet, the ice seems to have passed directly over them, while a few of them, by reason of their height, are left untouched. "The glacier, therefore," says Professor Hitchcock, from whom I here quote, "was God's great plough, and when the ice vanished from

the face of the land, it left it prepared for the hand of the husbandman."

But temperature, at a former period, was as much higher than the present as the glacier period was lower. The coal flora of Pennsylvania, Nova Scotia and other places have yielded more than seven hundred species of plants, all distinct from any now in existence, giving evidence that the climate of the surface of this portion of the globe, whose physical condition has undergone so great a change, is not measured by latitude and longitude alone. In our Canadian coal beds, species and genera have been discovered, showing that we have had a vegetation in places requiring an atmosphere more charged with moisture than that which now obtains. The vegetable productions met with must have required, not only a large amount of vapor, but also a considerable elevation of temperature; and both, in uniformly steady supply. In the eastern coal fields of Canada are met the remains of huge umbrageous trees and coniferæ which have now no living counterpart in our land.

As, in the past, this climate must have experienced great ameliorations, may it not be said of the present and near future: as the monarchs of the forest fall, and the soil is exposed to the genial influence of the sun, will not winter break up earlier, and snow and ice disappear sooner than heretofore?

The removal of our forests, and the drainage of our swamps have had, and are having, material influence on the health of the people. Intermittent fever, which only a few years ago was prevalent in many districts in this country, is rapidly disappearing. The laborer who clears streams which had become choked and overflown, and whose waters served only to form pestilential marshes, does, in his own way, for health, what medicine could not effect. In like manner acts the cold air of winter; it sets particles in

motion, and particles in motion lose their power of decay. Cold air, when in motion, sterilizes matter that is peccant, and as cold days are the clearest, they are also the purest and the healthiest.

As evidence of the sterilizing influence of the cold, clear atmosphere, it may be stated that in all the different latitudes of the northern portion of this continent, the Indian woman practises a mode of preserving meat of the buffalo, red deer, caribou, moose and other amimals by drying it in the sun, without the addition of salt or smoke. In western districts this is often done also in the summer months.

While the air is drier, it appears also to be more highly charged with electricity than is that of the west of Europe. It is not unusually sensible. In our clear weather the electrical condition of the atmosphere is vitreous or positive; when clouds drift with violence, the atmospheric air often becomes negative; but a change of wind may alter the electrical condition at any moment.

The air is also, in the highest degree, stimulating. It is such, in that respect, as to have arrested the attention of many Europeans travelling in this country. Persons who are disposed to add a little wine to water, for their stomach's sake, will not fail to notice, that stimulating beverages do not agree with them quite so well as in Europe; and they often seek, in the fancied impurity of the article, and not in the hyper-stimulating influence of a drier climate, for the cause of that difference. The lesson is usually learned in time.

How does this climate influence germination and growth in the vegetable and animal worlds? To what extent are we affected by it? Is life more intense? Is the existence of a tonic excitant in the atmosphere prejudicial or favorable to mental and physical development? To life? To health? Although the element of time is wanting which would have effected more marked developments, such partial

answers as I am able to give, in the few moments which are at my disposal, I shall lay before you.

Soon after his arrival here, the European will not fail to notice that herbage generally—foliage, plants, flowers, shrubs, forest trees — are much unlike their European cousins; and that a new fired ambition seems to have been infused into many of them. Vegetables and fruits brought from Europe often soon experience remarkable modifications in their growth and physical qualities. Illustrations are numerous. Let me cite one or two: The maize, for instance, which, in Europe, grows only, if at all, to the height of a child's knee, here overtops a man on horseback. The Scotch thistle — a lowly but always troublesome weed which comes up everywhere without the aid of the husbandman — in its native Scotia keeps humbly near the earth. Here it rises to the height of a Roman spear.

The faunist here meets with numberless instances of the effect of climate on animal life; and he may recognize the changes effected in certain area, and in certain periods of time. Nor is the time required, in some instances, a geographical epoch. Mention may be made of the ox and the hog, which are unquestionably of European origin. A couple of centuries is the average limit of their existence here. The ox is found, in one place, with short, broad head, like that of a bull-dog; in another, with prognathous under-jaw; in one place, with broad outspreading horns, and in another, hornless. His size, color and disposition, even, have been variously affected in different parts of the continent. The hog, brought to this country and allowed to roam and to root for a living, almost in a couple of generations has the long, strong snout; and in a few more generations has the lengthened legs, the long head and many of the characteristics of the wild boar in appearance as well as in fleetness. Here, the birds are decked in much gaudier colors than are those of Europe, but they sing less

sweetly. Some of those met with in Great Britain have here brighter plumage, but the air resounds less with the music of their carols.

The effects on man are slower, but, in the end, equally appreciable. The aborigines of North America, after centuries of residence in this climate, differ in many and important features from the Asiatic stock from which they are undoubtedly descended; while the whites of one or two generations exhibit, in many instances, a marked departure from the original type.

Looking to his fellow-man, one will observe that those who preceded him to the New World have experienced, even in one generation, but more markedly in two or three, the modifying influences of all the complex circumstances which, in their *ensemble*, constitute climate.

This country is peopled, in large measure, from the Eastern shore of the Atlantic, and it may not be uninteresting to the immigrant to note the changes which have occurred in the appearance and constitution of those who preceded him — changes as noticeable as those of residence, food, occupation, amusements, etc., which are sometimes with, and often without the immigrant's own choosing.

The new form of existence to which the European is exposed engenders new habits and new modes of thought. The natural, the national character, even, is, after a time, and sometimes after a short time, modified to suit the new order of things. It may be observed, for instance, that business and pleasure, labor and rest, toil and recreation, are here not too well assorted; that toil is more severe and more continuous; that men work harder that they may earn more; and that recreation too often partakes of the active character of dissipation rather than of *delassement*, diversion or amusement, save when an element of refinement has been blended with the more progressive element of enterprise. There is observed, on all sides, an earnestness in

manner, and in speech, which is begotten of new interests. Transplantation alone — even if attended with a greatly ameliorated condition, like over-exertion in him who is compelled to toil, and too little exercise in him whose labors have assured for him an early competence — produces certain changes in the economy. These changes at first do not always seem to be favorable; and have often led to unfavorable comment.

Opinions have been formulated by Dr. Knox and others that this climate is inimical to the white man; and that were it not for a constant influx of European blood, this continent would again revert to the red man as its sole possessor. Those who hold that opinion endeavor to show that the low birth-rate, noticeable among some tribes of the aborigines, and latterly among the whites, is evidence of the baneful influence of this climate.

Low birth-rate, when met with among the Aborigines, is susceptible of easy explanation. Lafitau, upwards of a hundred and fifty years ago, drew attention to the scanty prolificacy of many of the native women of America. But in most instances the explanation, says Waits, was of a kind as to exclude the idea of an original defect of the race. The procreative power of a people has, within certain limits, a relationship to the ability of the soil to support its inhabitants. When the population exceeds that ability, other and newer restraints come into operation, either to check, to limit, or to destroy. Agriculture is almost unknown to the Aborigines; and supplements, to an insignificant extent, the uncertain subsistence acquired by the chase. Some tribes live almost entirely by hunting; some by fishing; some, at times, by both. Fishing necessarily implies living, in moderate numbers, near the borders of lakes and rivers, at certain seasons favorable to fishing; while hunting necessarily implies still more moderate numbers, in one place, and a still greater extent of country to roam

over. As food is limited in quantity, and cannot always be brought together for future necessity, and as the pursuit of wild animals compels the hunters to move quickly from one place to another, it follows that food at times is scarce, and too often insufficient. Scarcity of food is less a hindrance to population than are the enforced scattering of the tribes, and the enforced neglect of the women by the men of the tribes. In places where food is more abundant, and where men are not obliged to keep greatly in advance of the women, the latter are more valued; but at all times woman's lot is a pitiable and an anxious one. Her work is never at an end. Her husband kills the game, but everything else is done by her. The life of incessant watchfulness, in which both men and women are obliged to live; the fatiguing marches, and the accidents incident thereto; the state of unrest and alarm; of ceaseless danger and violence, although borne with unmoved patience, and with no outward manifestation of concern, too often disturb the current of gestation. Pre-natal life, therefore, among the Aborigines, is not without its unsought dangers.

But other limitations are met with: If a woman has twins, one, only, is permitted to live. The destruction of infant girls is not rare. They are destroyed in revenge for the faithlessness of the father — and especially if the father is European. If a child is born with any deformity, it is exposed. The healthy, strong, vigorous and well formed child is alone permitted to exist, and upon that one the mother's attention is lavished. She suckles it for six or seven years, and, for prudential reasons, that time may be still further extended, and during the period of lactation the husband does not disturb her. Where Christianity has not penetrated, there must be added: a practice of procuring abortion; but where Christianity has been embraced, the male does not demand and the female does not rid herself of her burden to please either herself or her selfish lord.

Among the Winnibagoes, the Kenisteneux, and other tribes, when the birth-rate is small, it has often been traceable to artificial abortion and infanticide. There is abundant evidence to show that the women of many tribes possess a knowledge of abortive draughts.

Where the tribes are not exposed to too much misery; to too severe fatigue; or to too great an abuse of spirituous liquors, the prolificness of the women quite equals that of the whites. On the North West, North and North East coasts, the women are very prolific. Among the Indians of the North, it is considered exceptional if the number of children amounts only to five or six. Among the Chippeways, the average number of children is four. Sterility among them is considered a disgrace, being looked upon as the consequence of incontinence. Among many of our Northern tribes, the average number of children is six, and among the Mandans, the gentlemanly Mandans, as they are styled by Catlin, where order is established, and where there is freedom from anxiety, the number is often ten or more.* In many tribes it has been noticed that when a native woman is married to an European, in her new found condition of peace and safety, she is prolific. The same may be said of her, wherever Christianity has been introduced, and wherever the woman has been taught a just appreciation of the wickedness of tampering with gestation. The rapid decrease of the native population in no way favors Dr. Knox's view of the pernicious influence of this climate. Where the decrease has been greatest, apart altogether from the general producers of decay, there are other

* It is a singular fact, noted by Abbé Lacombe, that wherever polygamy exists among the Aborigines, the number of births is smaller than among the monogamous. This is different from what is believed (but on insufficient data) in the Eastern hemisphere. The Mahomedan is told to be polygamous that he may raise more children; the Christian is told to have one wife, for a like reason. Christian and Jewish families in the East consist of a greater number of children than Mahomedan families, where polygamy exists. And that experience is repeated on this continent.

special causes which one must look for, in local conditions, and "not in an organic defect of the race." One is the coralling to which the aborigine is subjected; and the privation of game, for which he once hunted:—

> "When he welke in the lande,
> With his bowe in his hande
> Under the wilde wode wande,
> He wexe and wele thrafe."

Between the Teuton and the native there has been little union in wedlock, and little effort or desire on the part of the former to establish a family. With the French it is not so. Wherever the early missionaries went, the people were taught not to dispossess the natives, but to marry among them; not to rob them of their property, but to beget children in wedlock to inherit it, and the result, to-day, is a considerable admixture of French Keltic and Indian blood, with many of the characteristics of the red man preserved, but modified by repeated dilution with the European stock. The mixed race is a productive one; has good staying power; and is less subject to certain diseases than are the descendants of the native and other nationalities.

It has been stated that the result of the union of two races may be productive, but that the difficulty of rearing the children is greater than among the peoples of either contracting party. In other words, that the Mestizo becomes sterile after a time, or begets children having inferior staying power. So far as my observation extends, physical and mental health and vigor abound in the mixed race of French and native, and any deterioration occasionally noticeable is due entirely to local conditions. Of course, the infusion of fresh blood, after the first union, is entirely from the European side. There is no native race to draw from. The native type, after a few generations of dilution, is greatly attenuated and often seemingly lost; but it is not so, for circumstances ever and anon occur to show, so plainly,

the latent vitality of the native type that we are led to acquiesce in the belief that the qualities of race are permanent.

Permanency of type in the human form is a phenomenon which could only appear after a long continued influence of climate, of mode of life, of external relations, and so forth. What would have been the result had the European and native elements been equally blended; had the sources of supply of new blood continued to be furnished in equal proportions by either side; and had the conditions as to food, clothing, cultivation, and freedom from danger; in a word, had all the relations of social and national existence been identical? This is a matter of conjecture, on which the disciples of a Pritchard, an Agassiz or a Quatrefages may speculate. I here only record the fact that a section of the European stock, transplanted to this northern region, has not only maintained itself, but has absorbed what it could of the native stock, forming a *new* type, seemingly endowed with all the signs and attributes of mental and physical vigor; and that the mixed breed has not the characters of the hybrid.

The occupancy of the soil by the European is still recent, but sufficient may be gathered, even by the most superficial observer, to satisfy him that, except in one respect, the prognostications of the pessimists are *not* being fulfilled. The exception to which allusion is made — and with great reluctance — is the low birth-rate in many parts of this continent. Some writers cite the low birth-rate as evidence of Knox's sagacity and discernment.

That it is, in many places, phenomenally low, it is needless to deny. Some go even so far as to assert that woman, on this continent, is becoming physically unequal to the functions of conception and of child-bearing; that she has reached such a degree of melioration and improvement as to have had produced in her, as it sometimes happens in

vegetables and animals too far removed from the normal type, a condition well-known to naturalists: an inaptitude of reproduction; while others claim that the large number of types or races entering into our cis-Atlantic family is prejudicial to fecundity. There is nothing in analogy to favor that view. Wherever, in the vegetable and animal kingdoms, there has been a mixing of type or race, the resultant has usually been fecund in an exceptional degree. Others assert that woman is becoming apathetic to the maternal instinct, and desirous of being exempted from the duties and inconveniences born of her marvellous mechanism, and of her exalted mission. What does woman say to this question? I speak not of the sterile woman, who is sterile through no device of her own. But what says the barren, or partially barren, and by set purpose? Female writers (and there are many) answer unhesitatingly: that as to woman, alone, is the burden of the pregnant, and the suffering and the danger of the puerperous, to her, and to her alone, is the decision: pregnancy or no pregnancy. And what is man's position in this matter? He is what woman makes him. It is to woman — not to man — that "la nature et la société donnent une grande habitude de souffrir, et l'on ne saurait nier que de nos jours, elles valent, en général, mieux que les hommes." It is to *her* must be looked for relief from this abnormality.

At no period in the earth's history has woman had less excuse for independent action than at present, for at no period in the earth's history has woman stood higher, or more deservedly higher, in the social scale, and in no country higher than in America. But the disturbed birth rate has a cause. In a word: It is a love of luxury.

This is an age of luxury; yet it is an age of poverty, for it is an age of inequality of fortune, and luxury and poverty are always in direct ratio to that inequality. In countries where riches were formerly somewhat equally divided, there

was but little luxury, and any attempt at a display of it was frowned upon. Plato made luxury to begin where poverty and want terminated. When absolute want existed, the state of luxury in the individual was supposed to be at zero; but where that condition ended, luxury again existed. Our wants are now so many and so artificial, that luxury is deemed to commence, not on the threshold of poverty, but only when all ordinary, and legitimate, and even fictitious wants are satisfied. To-day, luxury is fenced off from poverty by the broad and ever broadening wall of comfort; and comfort is often not recognized as such till it is parted with.

Man is vain, and craves for distinction of some sort. He carries with him a desire not to be lost in his surroundings. In cities, men are not producers, as are those who follow agriculture; yet must they toil that they may be distinguished, in some way, from their fellow creatures. In rural districts man's existence is of itself distinctive and noticeable without much effort on his part. But when men congregate together, longings, desires, fancies, are greatly multiplied. With many it is a desire to appear distinguished by luxury, the most absorbing of all pursuits; the most selfish, the most heartless, the most unsympathetic. One who desires to be distinguished in that way has no satisfaction in seeing others distinguished in the same way. Ambition, in that direction, is to remain alone in the firmament where luxury reigns, and reigns only to be exhibited.

It was a catering to, a pampering of a love of luxury, which caused the principles of Malthus, with regard to population—the limitation of mouths to a known food supply—to be so readily adopted. And may it not have been a love of luxury which has led to the adoption of some of the doctrines of evolution which place the human embryo on a lower plane than it was intended to occupy, making it a part, and but a part, of a large whole; a mere link, and

nothing more, in the chain of creation? The desire for luxury, in every class and condition of society, has much to do with the disturbance of the normal birth-rate. It surely cannot be that, in a country so new, and so favorably circumstanced in all things material, this disturbance is as one of the results, visible in the past, in almost every ancient Empire and State in the universe: a too rapid transition from poverty to wealth; and a too rapid transition from wealth to corruption.

It is the love of luxury, in some form, which too often impels the humble, the well-to-do, the rich even, to thwart the designs of Providence in their regard; to question the *raison d' être* of gestation; and to reduce to nothingness what was, if not life, at least anticipated life. Let not climate be held responsible for what does not belong to climate, and is not begotten of it.

In many portions of this continent the expedients are many to thwart, even in married life, the purpose, and the only purpose, of the union of the sexes. Addressing, as I do to-day, the more distinguished members of a God-like profession, let me ask: Is there one of us who has not been solicited to relieve, not an unfortunate of the illegitimate burden which brings shame, and disgrace, and exclusion from society; not a distressed one, to whom our sympathy, our pity and our commiseration naturally go out; but one of wealth and fashion, who will not suffer herself to be debarred, for a time, from society; or who may think that the means for living even in luxury will be crippled by a new arrival; or that the discomforts attendant upon the pregnant state may be irksome? And who, amongst us, has not had, in return for not yielding to those importunities, the enmity and the ill-will of those who solicited, and solicited in vain?

But a more serious disturbance of the birth-rate is that obscure, that nameless expedient which obtains in married

life, and often in that phase of it, entirely removed from the possibilities of want. Not a few claim that they entered upon the married state uninformed as to its obligations, and decline to fulfil them. These are the fallacies, Gentlemen, which you and I have to combat, and with what success I know not, and you know not; for the love of luxury, of society and of ease is strong indeed.

But let us, members of a God-like calling, whose function it is, not to check life but to save it; not to hinder but to favor the possibilities of life existent or anticipated, not furnish to wife or husband any pretext for acts which place them below their proper plane.

I may say, in this connection, I cannot hold blameless those members, if there are such, of my profession, who lightly and unthinkingly counsel or lend their sanction to the avoidance, by the married, of the risks and responsibilities of maternity, on the plea that health might suffer. Accommodating counsel of that nature is often sought for as a pretext, for doing what has already been decided upon. Health, the timid may safely be assured, is more commonly met with where children are than where they are not.

There is, however, here and there a brighter aspect to this dark cloud. In all classes of society where malthusianism has not found root, the birth-rate, all over North America, is large. That of the French residents on this continent is phenomenally large. With them pre-natal life is safe; although post-natal life is less secure. We cannot, however, fairly attribute to climatal influence, deaths arising from imprudent exposure; improper clothing; food in excessive quantity, and often of unsuitable quality; and from a large and rapid birth-rate, which deprives the infant, at a very early age, of the immediate care of a mother whose attentions are more urgently needed for a newer arrival.

In Canada, upwards of sixty per cent. of all the children die under five years of age. In Great Britain, the death-rate is between twenty-eight and twenty-nine per cent. for the same period. The explanation may be found in large measure in the records of the French Canadian people, where the death rate is large — but where the birth-rate is in much greater ratio.

In 1763, when Canada passed from French to British rule, there were seventy thousand inhabitants. Ten thousand, it is estimated, returned to France, rather than change their allegiance. Sixty thousand—men, women and children—remained in Canada, and in 135 years they have increased in a ratio never, perhaps, equalled in the history of a people. Their descendants to-day are upwards of two millions and a quarter!

The children born in the northern portions of this continent have certain advantages conferred upon them at their birth. It has been established by MacCallum, that those born in the Maternity hospitals of Montreal exceed, very considerably, in size and weight, those born in the city of London. If children are thus favorably handicapped at the start, why should they not

"The van, in life's stern battle, well their ground maintain"?

Do we continue to hold, until the end, those exceptionally favorable conditions which presided at our birth? We hold them for a certain period, when we part with them, and place ourselves under *less* favorable conditions. Life insurance companies—so keenly alive to their interests, and so well qualified to protect them—exact a *less* premium for youths and adults in America up to thirty-five. From thirty-five to thirty-seven, the premium in Great Britain and here is about equal; but after the age of thirty-seven, it seems to be recognized that we, in this country, draw upon our strength unduly, and the premium is increased in consequence.

Of two human machines, equal in strength, structure, vitality and power of endurance, that one will *last longer*, and do as much work, which is the more judiciously handled. On this side of the Atlantic, especially in cities, one seems to live in a state of undue excitement. The hurry and the rushing, the undue eagerness and unrest of cis-Atlantic life, are *not* conducive to health or longevity. Yet competition in all that comprises the struggle for existence, or the pursuit of wealth, need not be so great on this continent as in Europe where population is more congested. Du Chaillu speaks of the merchant in the north of Europe turning the key in the lock of the door of his store, at noon every day; retiring to his quarters in the rear; there quietly eating his dinner with his wife and children; smoking his pipe, and opening the door again at 1 o'clock. Could that be easily done in New York, for instance? It might be a dangerous experiment even in this staid city. Yet that leisure hour would probably add several years to the sum of the man's existence and much to the sum of his comfort.

It may be laid down as a safe rule that the habits of those indigenous to the soil, or who have been long in possession of it, with such modifications as increased comfort will permit, are the best suited to the climate. We, the descendants of the whites, have departed widely, in many respects, from this safe and reasonable rule.

It is wisdom in, and it is to the interests of new settlers, however excellent their habits may have hitherto been, to renounce them so soon as they perceive that the habits of those amongst whom they have come are better suited to the new order of things. The aborigines, and the early settlers, were in the habit of clothing more warmly in winter those parts of the body most requiring it—the feet and abdomen. Europeans, in coming to this country, alarmed at the frequency with which chest affections of an inflammatory character are met with, protect unduly the chest.

We often see, among the children of immigrants, five, six or more coverings of the thorax in winter; a less quantity covering the abdomen; and still less covering the feet; while a fur cap, thickly lined, covers the part of the body least requiring warm covering, and the part intended by nature *not* to be covered. It is often found to be difficult to induce an immigrant to transfer a part of the chest covering to the abdomen, or to the feet.

We commit many errors in the choice of food, and in its disposal. In the great variety, and in the unsuitable nature of food, luxury, even amongst the poorest, again obtrudes.

As a general rule we eat too much, far too much, and more than the body requires. We have not all learned the counsel of Cicero: "Tantum cibi et potionis ad hibendum est, ut reficiantur vires, non ut oprimantur."—"Meat and drink should be taken in sufficient quantities to invigorate our bodies, but not to overload or oppress."

We eat too fast. We do not prepare our food properly in the mouth to undergo the changes which would follow upon adequate mastication and ensalivation. When one eats slowly, one generally eats moderately, and the converse is equally true: when one eats rapidly, he generally eats too much. We take a greater variety of food than the stomach can dispose of. Some portions of a meal are often incompatible with other portions of the same meal.

We drink too much while eating, and too near the time of eating. We forget that drinking and eating are separate and distinct acts; for separate and distinct purposes; and should be performed at separate and distinct times. The lower orders of animals understand this, and leave to man the monoply of error. The departures from the normal and the natural are the usual causes of those derangements of the digestive functions which are now so widespread as to be considered national. The nostrums which are being constantly thrust upon the market, with ever-recurring

claim for superiority and exclusive efficiency, fall short of their commercial value if they do not claim to be serviceable to the dyspeptic. No matter how numerous may be the ailments advertised to be relieved by them, a stray shot or two must be provided for dyspepsia.

It is to be borne in mind that there are two, and but two, purposes to be subserved by food: one, to build up the fabric of the body; the other, to sustain its heat. These purposes are not the only ones served by our modern hotels, where appetite is often spurred beyond its own proper sense, and where there is submitted for assimilation much that cannot be assimilated. It need not be wondered at that disturbances of the digestive functions are many and various.

The modern custom of hotel and boarding-house life, where the habit of greediness is under but slight restraint, and where a great variety of food is at hand for the asking, is an unfortunate one for the people. Persons from the rural districts, having clear complexions and strong teeth, often find, after one or two years in the city, that they are without their teeth, and have complexions closely resembling the saleratus pastry which had been substituted for their plainer food. In factory towns people at boarding houses take pie at one meal—usually dinner—but before many weeks are over they are eating pie or pastry of some sort three times a day, when they find they have no appetite for simpler or plainer food. Pickles, sauces and condiments of various kinds, and green tea, are used largely as stimulants at every meal, and with baneful results. This mode of living has extended to country districts, and the farmer is not satisfied if his meals are without tea and pastry. Liquid meats, essence of beef, beef extracts, beef teas, soups and broths are often substituted for solid food, and the fork and knife are too often discarded for the spoon. It is amazing how strong a hold these trashy articles of

consumption have upon the imagination of the people, and even, I am sorry to say, of some physicians. Yet many years have elapsed since scientific experiment, by a select committee of a learned society, has established the utter worthlessness of liquid meats.

The rapid acquisition of wealth in this country creates new desires, and the number and extent, and may I not add the folly, often, of those desires, are generally in direct ratio to the suddenness with which one has been placed in position to gratify them. The simple food which our forefathers grew and strengthened upon is no longer the food upon which their descendants are content to live.

If any one is disposed to doubt, let him visit, at meal time, any boarding-house or hotel; see what is put into that wonderful alembic, the stomach, to be transformed, forsooth, into healthy blood for the repair of wasted tissue, and he will admit that if any chemical action can harmonize all the antagonistic and opposing ingredients entering into the composition of *that* meal, then the age of miracles is not at an end.

It would be impossible to enter intelligently into a consideration of all the articles which constitute a single modern meal, and the unwisdom of their selection. I shall allude, however, to a very prevalent error: that of taking iced water at the beginning, and hot coffee at the end of a meal, alternately contracting the enamel of the teeth with the former, dilating it with the latter, till it fractures and fissures and ceases to afford protection to the delicate structures within.

It would appear as if, in all our large centres, the time spent in eating is considered to be lost. We have become a nation of fast eaters. In former times an hour was not considered too much for the mid-day meal. That was diminished to three quarters of an hour, and in many places in this country the usual time is not more than ten to twelve minutes. In factories and shops a half hour is al-

lowed, in which to go to the boarding house, eat, and return to work. That is the average time occupied by the broker or the merchant for his mid-day meal, and his run to and from his office. Business men err most in this respect, and workmen and workwomen are coerced into line. I have already stated how our digestive organs suffer by the change, but that portion of them which suffers most is the masticatory apparatus which was destined by nature to last as long as any other portion of the skeleton.

The early age at which persons lose their teeth is claimed to be due to the baneful influence of our climate. If so, is it our hot southern climate? It cannot be; for the negro, as a rule, has good teeth. It is not our cold northern climate, for the aborigines in the extreme north have good teeth. In the course of time their teeth may wear away, and crumble from a sort of rheumatic trouble; but that is in old age. The Esquimo woman does that which the white woman usually does not: she is constantly using her teeth. In addition to chewing her food, she chews the skins of various animals, and converts them into soft, pliant material for thongs and cords. She is the tanner of the north; and while the incessant use of the teeth softens the material thus treated, the teeth themselves are hardened and strengthened, and made more durable by the process. With many of us, apart altogether from the kind and quality of the food used, the *disuse* of the teeth is, with many, the cause of their early destruction. This is but an illustration of recognized physiological laws: exercise of a part or of an organ is necessary to its continued healthfulness; and disuse of a part or of an organ favors its decay.

I have elsewhere written at length on this question, and I have said—I here repeat it—that the alarmingly early destruction of the teeth in people generally is not due to climatal influence, but to a faulty mode of living. I have said: the aborigines have strong and very white teeth. Wherever

their skulls are found, they usually contain complete sets of teeth—natural teeth. I have to add, however: as they become corralled and enclosed, and are forced to live like white men, in their pent up condition, their teeth decay. The half breeds, with something of the habits of their white parents, have teeth less healthy than are those of their red progenitors. But so long as they live in the open air and partake only of the simplest food, prepared in the simplest way, and taken without condiment, their teeth remain good.

How puzzled would be the future antropologists were they to visit the cemeteries of to-day, and endeavor to establish, from an examination of our toothless skulls, what we fed upon when we were in the flesh. Many a learned treatise would doubtless be written, to prove that we were neither rodents nor ruminants; that we could neither bite, nor tear, nor grind, for we had neither incisors, nor canines, nor molars; and perhaps some one, more fanciful and enterprising than the rest, might start the theory that we were a race of infant giants swept off the earth by some great cataclysm, some violent action of overwhelming force, ere our teeth had time to develop.

I should not allude at such length to this subject were it not that we are not alone the sufferers. We are transmitting to our children, in every successive generation, teeth that are becoming thinner and thinner in enamel, and more and more brittle in dentine, and we are wholly responsible for the change.

There is another habit to which I shall allude as being productive of many ailments—the habit, so much indulged in —of expectorating or spitting. Of course, it is confined to the ruder and less educated classes. It prevails in some parts of the country to a much greater extent than in others, and necessitates an appeal to art in the interests of the suffering housewife. Hence the presence of ornamental

suggestions, termed cuspidors, which in some houses seem to be considered as eligible for drawing room, dining room, bed room and kitchen.

I cannot help thinking that if the women inaugurated a crusade against the disgusting and unprofitable practice, it would quickly discontinue. It is a habit more easy to overcome than any other. I do not know the origin in man, of ejecting the valuable secretion from the mouth, or to what particular country society is indebted for its introduction; but apart from all other considerations, it is largely, very largely, conducive to gastric disturbances. One throws away what is essential to digestion and then goes to the dead hog, or to the dead calf, for its equivalent. It is no consolation to know that the lower the order in the social scale, the more general is the habit. We have almost a monopoly of it, on this side of the Atlantic.

Let me turn to man in his natural and normal state. In a state of nature he partakes, in a large degree, of the influences which surround him. His history, so to speak, is comprised in that of organic nature. It would never have occurred to any one to imagine our magnificent primeval forests peopled with anything but animals of superior strength and development; or with man otherwise than in majestic and well-formed proportions.

Such were the forests; and such was he when we came to disturb the one and the other. I do not stop to inquire, interesting as it might be, whence came the aborigines of this land (although I hold that Asia was their original home, as it was the home of their European dispossessors). They are claimed by some to be more ancient than any of the human family in the Old World; by some to have inhabited the land from which they are being rapidly removed, upwards of fifty-seven thousand years; according to others, they go back to the antediluvian period; to many, even to the tertiary period of the earth's development.

Whatever may have been the time of his advent, his long residence on this continent has certainly developed a superior type of man. Usually the stature of the native is much above the medium size. He is straight and well-formed. He is built such as nature built him, and in keeping with his surroundings. He has great physical strength and great power of endurance. He has no occupation to develop the muscles of those portions of the body which are required to carry heavy weights; but in all feats of strength and endurance, victory has usually been with him; although in public exhibitions of strength and agility, we have been so unfair as to take, hap-hazard, from among them a few men of a tribe, as representatives of a whole, and to set them in opposition to picked men from among ourselves.

In those portions of our cold northern climate, home of the Huron, the Iroquois and the Loucheux, Simpson has observed that in matches with the men of his party, the great strength and activity of the natives were conspicuous; yet the *voyageurs* who contended with the natives were men chosen for their strength and powers of endurance. Some of the feats of those people read as the tales of the "Arabian Nights." Many of them can travel a hundred miles in a day, without nourishment, and without repose. It is, doubtless, from the climate and the soil and its products, that results this superior physical development of the race. The aborigines had nutritious plants and edible fruits, and wild animals in abundance; and every stream and streamlet was stocked with fish. But these alone were not enough, for the same state of abundance prevailed in Australia.*

When this portion of the continent was discovered, the aborigines were a proud race; of dignified bearing, mild

* The population of Australia, according to Seemann, "is the oldest as well as the lowest in the race of man; a race incapable of mastering any religious teaching whatever, unfitted for civilization, and so near the brute creation that it might be appropriately classed with it, were it not for its power of language, and the only thing in its possession—the boomerang."

in peace, but terrible in war; "*magnum in bello, nec non minor in pace*"; maintaining order without the restraint of law; and uniting, in the closest ties, the members of the same community. In speech their figures are simpler than are those of warmer climates. Their legends have many traces of the grotesque and the terrible; and speaking but seldom, they record their assent with a "hoogh," a dissent with a "kaween." (I allude to the Iroquois.) Yet they speak with a quickness of perception, a delicacy of taste, and a fluency of expression which an Erskine has studied to imitate. Erskine found that the children of the forest could clothe their sense of meaning with expressions that were simple, yet forcible, and always natural. Their forbearance in speech; their habitual silence and reserve, were probably due to the influence of their majestic surroundings, where

> "Many a legend peopling the dark woods,
> Nourished Imagination in her growth."

Where has the aborigine of other countries had so much in nature, and in climate, to stimulate him as in this land where the marvellous poetry of nature is everywhere? But while he is dwindling and declining and dying out, displacing tribes are growing from within, and more largely, by rapid addition, outwardly, of new parts, and these are being moulded, shaped and fashioned by circumstances of time, climate and common interest, into one integral and undivided whole.

The rapidity with which persons from different countries here throw aside their distinctive and most pronounced characteristics is only equalled by that with which they change their language for another, the language of one of the most important constituents in the new existence. The Anglo Saxon, born a Hindoo, of an Aryan mother, a thousand miles north of the Arabian sea; a mountain climber; a lover of nature in her rugged features, or in the placid aspects of pastoral life, he has carried with him the

vigor and intrepidity of a, now bold, now peaceful, but always a sturdy race. From mountain fastnesses in the north of Asia, he swoops upon the inhabitants of a narrow strip of land known, to-day, in the map of Europe, as Schleswig-Holstein, where he takes to the water as naturally as the otter. After disporting for a time, now in the North Sea, now in the Cattegat or the Baltic, he possesses himself of what are now the British Isles, and is at once a viking or bay man, a mariner or wickman; alternately peasant and pirate, and pleasingly or terribly earnest as either.

And now, again, having insufficient elbow room in his pent-up Isle, he clutches the head lands over many of the maritime portions of Europe; revisits Asia, the cradle of his birth; appropriates large portions of it; raises his standard in parts of Africa, offering ever, it is claimed, higher civilization and better commercial advantages, but, in return, rarely neglecting to appropriate the land. Europe, Asia, Africa, are yet insufficient for his power of expansion and absorption, and the Western continent bends to his sway. Here he founds a constitutional monarchy; there a republic; here an untrammeled governorship; there a tribal direction, each adapted to its environments. Here he imposes laws of his own creating; there he enforces those he found already fashioned; but whatever system of politics, or whatever method of guiding and directing the affairs of state he may select, he displays a power of colonizing, and an aptitude for governing which are phenomenal.

The Anglo-Saxon on this continent, as elsewhere, always self-reliant, not seldom aggressive, has gathered up and appropriated and modified qualities which are begotten of all the circumstances of climate. The qualities which have given such prominence and individuality as to mark a distinct variety in the species, will here have, in peace, prosperity and freedom, abundant opportunity for reaching a high state of physical and mental excellence.

And yet, from recent events,—for the prophecy of Isaiah is not yet fulfilled: "neither shall they learn war any more," —it would seem as if in this Western World, old instincts are not extinguished, and ancient desire of conquest still lives.

Older still, as a distinct branch of the Indo-European group, having an origin in the undefined misty dawning of the human family in Asia; of the same Aryan mother, peopling France and Italy, Spain and portions of Germany, Ireland, Scotland and Wales, the Kelt has brought his distinctive qualities hither to aid in the formation of a new nationality.

Will the qualities which to-day distinguish each, remain distinct? Or will they be so intimately blended in the future, that the identity, the individuality of the contributors will be lost in the general product? This is a problem which is being worked out on a scale never before known in history. Whatever may be the outward form of this new nationality, and whatever may be its chief mental attributes, I hold, with Brinton, that "the first object of nationality is unity in all the relations of national life; and that almost the first aim of nationality is physical unity."

This physical unity is not now, and will not be in the future, in the perpetuation of a resemblance to any of the parent stock. While it may be admitted that the qualities of race are permanent, those qualities are permanent only when not interfered with by the admixture of other qualities, from other races, equally tenacious of continued existence. Physical unity, in the end, will be unity of a new type, as distinct from any of the present types as the present types of European stock differ from one another. In welding the constituents of the new type there will be compromise and compensation, whatever may be the changes which will have occurred in the appearance and constitution of those who were born in this land, of cis-Atlantic progenitors. When, in time, the various peoples

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(with aptitude to absorb, and energy enough to reject what is not amenable to absorption) shall have been welded into one mass, and not as by autogenous soldering, what manner of men will they be?

Sufficient is already here and there noticeable to enable one to say, in general terms, that they will be less ruddy; that the peasants and out-door artizans will be browner, and more bronzed as it were; that the softness and moisture of the skin—conspicuous features on the other side of the Atlantic—will be here replaced by greater dryness of tissue; that the foreheads will be higher, much higher, perhaps not broader; that the hair of the head will be darker, straighter, coarser, and that of the face less abundant; that the nose will be sharper, the alæ thinner; that the chin in its curve will be even more strongly suggestive of fixity of purpose; that the malar bones will be more prominent; that the shoulders will be squarer and higher; that the arms, the legs and perhaps the body will be longer—for man will doubtless be taller; that the muscles of the body will be more tendinous and aponeurotic, less distinctly muscular, and the muscles themseves will be less cushioned with fat; that the muscles underlying the skin of the face will be more prominent, which will give to the countenance a more thoughtful, a more serious—some may think, a more anxious expression. Should a better knowledge of hygienic laws prevail, and prevail it will, men will have learned how not to destroy their teeth, or jaundice their complexions by a too artificial manner of living. The long possession of wealth, and the knowledge in the meantime having been acquired of how to use it with judgment and economy, may lead our descendants to have another standard of excellence than money, and to realize that "a man's life consisteth not in the abundance of the things he possesseth."

A classical Greek adage, kindly translated for the youth

of that period, of whom I was one, and placed as an inscription at the door of the mental philosophy class in the University of Edinburgh—I hope it is there yet—read thus: "On earth there is nothing great but man; in man there is nothing great but mind." What will be the mental characteristics of those who are ultimately to cover this continent and to sway its destinies? Here again we have been favorably handicapped. While other nations have had, each, its separate and distinct history; its struggling to emerge from a primitive condition of infancy with all its weakness; of youth with all its follies and indiscretions and dangers; of manhood with all its vigor and boldness and self-reliance; of old age with all its weakness and decrepitude; this people, destined to be a distinct nation, has drawn all the more matured, more daring and more energetic qualities from other peoples and from other lands.

England has contributed the more manly qualities of truth and honor; Scotland: the solid elements of prudence and good sense; Ireland: generosity, warmth of heart and virtue; France: politeness, refinement, culture; Italy: the poetic sentiment, and the qualities begotten of a love of art; Germany: that thoroughness in mental and material things; Spain: a magnificent national literature (in the opinion of Lord Macaulay, the richest of any nation).

These, and many more, in greater or less degree, have contributed their quota, and are contributing daily to the formation, under exceptionally favorable circumstances, of a people, bright; intelligent; shrewd; practical; quick of perception; generous; enthusiastic for the betterment of all that is mental and material; courageous in enterprise; energetic and able in execution—a people with whom failure is but the prelude to renewed effort; a preface to action of broader scope and of greater co-ordination.